United States Court of Appeals

for the Second Circuit

APPENDIX

76-7490
76-7514

B P/S

United States Court of Appeals
For the Second Circuit

EUTECTIC CORPORATION, NEW METALS CORPORATION and METALLIZING COMPANY OF AMERICA, INC.,

Plaintiffs-Appellees and Cross-Appellants,

v.

METCO, INC.,

Defendant-Appellant and Cross-Appellee.

JOINT APPENDIX

VOLUME III OF EIGHT VOLUMES

(TESTIMONY — Pages JA439 to JA768)

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Q While at Metco, did you do any work on the nickel aluminum spray powders?

A At Metco?

Q Yes, at Metco.

A No, I did not.

Q Following that who was your employer?

A In December 1970 I went to work for Eutectic Corporation in research and development.

Q When, sir?

A In December 19701

Q And at that time to your knowledge was Eutectic already selling commercially Exotec powder?

A According to my knowledge, yes.

Q Did you play any part at all in developing Eutectic Exotec powder?

A No.

Q Are you familiar with the Exotec powder?

A I am familiar with the Exotec powder now.

Q Will you briefly describe the composition and structure of that powder.

A Exotec powder is an agglomeration of 5 percent aluminum, approximately 5 percent aluminum and 95 percent nickel.

Q How is the aluminum and nickel arranged --

A And some resin. The resin works as a glue.

Q Now, what function does the resin serve in the Exotec powder, according to your understanding?

A According to my understanding in this area it is to make this agglomerate powder, to make it flow.

Q To make it flow. Will you explain to the Court what you mean by "to make it flow" with reference to the Rototec gun.

A Your Honor, when you put powder (indicating) which comes in a cannister. Then you lock it in. There is a hole which has a diameter which is .069 and it goes in here (indicating). And it flows from this powder forth. And there is a flame over here (indicating). And so it flows into the flame (indicating). The flame has gases coming out so it is carried out by the gases.

Q So again what do you mean by the resin enabling the powder to flow? I am still not clear on what you mean by that.

A Now, if you have 5 percent aluminum and 95 percent

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nickel, that nickel being -- that aluminum being so fine it will stick around there (indicating), and since there is a very small hole it might get a little moister and clog up. It will not flow any further than here (indicating), since this is strictly a gravity flow.

* * *

Q Mr. Patel, I show you what is Plaintiff's Exhibit 9 and ask you if you can identify it.

A Yes. This is a letter I wrote to Fullam, Incorporated after I discussed with them on the telephone.

Q Which was sample 1? What powder was used to get sample 1?

A Sample 1 was used -- was prepared out of using commercially available Exotec powder.

Q Exotec powder?

A Yes.

Q Did you later receive a report from Fullam as to the results of their findings?

A Yes.

Q What did those results indicate to you?

A The report indicated to me that the new spray Exotec powder using standard oxyacetylene parameters in a spray coating you obtain only nickel and some aluminum oxides.

* * *

Q Since receiving the Fullam report, which was dated January 1972, did you perform any tests or analysis to determine the reaction on the Exotec powder?

A Yes, I have tested.

Q When did you perform those tests?

A Very recently. When?

Q Approximately when?

A In November.

Q Of this year?

A Of this year. Maybe October. I am not sure.

Q Where did you perform those tests?

A I performed those tests at Eutectic's lab in Flushing, the Eutectic Laboratories in Flushing.

Q Now, would you now describe to the Court the test that you performed on the Exotec powder -- other tests that you performed.

A Since I observed that there was formation of aluminum oxide --

(Continued on next page.)

Q I am sorry?

A Aluminum oxide, I wanted to find out what really happens when you -- when there is a reaction going on in the Exotec powder. I took 10 grams of powder, of standard Exotec powder, and put it in a small black graphite crucible. And in the laboratory they have small long inductotherm furnace which heats up into electricity and magnetism. Then I obtained potentiometer which measures the temperature. We heat up this -- with this potentiometer and the inductotherm furnace the white crucible -- I think it is made of magnesium oxide or aluminum oxide -- I don't know.

When the temperature reads above the melting temperature of aluminum, something like 2,000 degrees Farenheit, we place that crucible into the small inductotherm crucible. At the same time we flood it with high purity argon gas --

Q You said high purity. How did you determine or what steps did you take to insure you had a high purity?

A We took the argon bottles from the supply.

MR. CALIMAFDE: You had better keep your voice up.

A (Continuing) Then I and another gentleman, Mr. Balisprier, we try to observe what happens to the powder.

Q And what did you observe?

A We did not observe any reaction going on. The powder

got hot and stayed hot, hot means very high, orange color.

Q If there had been an exothermic reaction occurring what would you have expected to see?

A We would have expected that the reaction might have violently burst out changing the color of the powder to white, very hot white color.

Q And did such a reaction take place?

A We didn't see when we had argon flurry.

Q This was the Exotec powder heated to above the melting point of aluminum?

A Right, 2,000 degrees Farenheit.

The second experiment we performed we used -- we got another bottle, argon bottle, which had 2 percent oxygen, specified and certified to 2 percent oxygen in the bottles, and we changed the bottle, and we make it flooded again in the crucible.

Again we picked out -- we opened another 10 grams of Exotec powder, and in black crucible, and as soon as the temperature of the white crucible went up something like 2,000 degrees Farenheit we placed that crucible again to the hot crucible, the black crucible into the white crucible, and at that time as soon as the powder got hot we observed the reaction going on.

Q What kind of reaction?

A The exothermic reaction.

Q How could you tell that?

A The action burst out in a manner that you can see the temperature of the powder changing to white, very hot.

Q This you observed yourself?

A That I observed myself.

The third experiment we performed that we removed the bottles and we repeated the whole thing, same Exotec powder in ambient atmosphere, in ordinary atmosphere.

Q Just ordinary atmosphere?

A Yes, ordinary atmosphere. This time we saw also exothermic reaction going on only a few seconds.

Q I hand you what has been marked previously as plaintiff's exhibit 15 for identification and ask you whether you can identify it?

A This is a report I prepared on investigation of exothermic reaction of the Exotec powder.

MR. CALIMAFDE: Speak up please.

A (Continuing) Reaction of exothermic reaction of the Exotec powder.

Q Was there any discussion in the report of the test you just described, the crucible test? Does that appear anywhere in the report?

A Pardon me?

Q Is there a description of the tests you just discussed with us which appears in the report?

A Yes, it appears in the report.

Q Will you tell the Court where that discussion appears?

MR. CALIMAFDE: What page?

Q (Continuing) What page?

A Page 2 number 3 on the bottom. This is the one (indicating).

Q Mr. Patel, did you draw any conclusions from your observations in taking these tests you just described to us?

A My conclusion was this, that in Exotec powder, to have exothermic reaction you require oxygen.

That was my first conclusion.

Q From that could you determine the nature of the exothermic reaction taking place? From that could you determine the nature of the reaction taking place, the exothermic reaction taking place?

A I am sorry?

Q From that observation you just said that it required oxygen. Could you then make a determination as to the nature of the reaction? What the reaction was?

A The reaction was exothermic reaction.

Q Between what?

A Between aluminum and oxygen.

Q Did you then perform any other tests in the series you did recently at Eutectic?

A Yes. I performed other tests to verify the exothermic reaction, oxidation exothermic reaction of aluminum to aluminum oxide.

Q Would you describe those additional tests for us?

A To verify this observation that in Exotec powder reaction aluminum oxidizes to aluminum oxide, exerting a high amount of heat, I took pre-reacted alpha nickel.

Q Will you describe to the Court what that is?

A Pre-reacted alpha nickel, which is manufactured by ALCO, identified as PP66, and the brand name is Nickel Aluminite.

Q I note in your report on page 3 you discuss the PP66 as "the nickel aluminite powder"?

A Yes.

Q But is the powder in fact nickel aluminite?

A The powder is not in fact nickel aluminite.

Q How did you determine this?

A I determined it two ways, that I had a chemical analysis done on the powder and I had x-ray diffraction done on the

powder, and both the chemical analysis of the powder indicated the powder having 4.4 percent aluminum, and x-ray diffraction indicated that it is alpha. Now, when you have 4.4 percent aluminum it cannot make any nickel aluminide according to the phase data.

MR. GORDON: Your Honor, alpha nickel was previously discussed as a solution of aluminum and nickel on the far right hand of the paper.

Q Mr. Patel, what did you do with what we will call the AVCO alpha powder in your test?

A I took this pre-reacted alpha nickel agglomerated with approximately 5 percent fine size aluminum.

Q Was this done in the manner of the Exotec powder as far as the aluminum being agglomerated?

A It was done in the same manner as the Exotec powder was being prepared.

Then I performed three tests on it. I took standard Exotec powder, agglomerated alpha nickel, and I took straight alpha nickel right from the can container where you get from the powder.

Q Would you describe what you observed in the case of each of these three tests?

A This powder --

Q Are you referring to your report?

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A I'm referring to Appendix 3.

MR. GORDON: Perhaps if your Honor will look at the original photographs which are somewhat clearer than in the exhibit book, your Honor, you might find it more advantageous (handing).

A (Continuing) That picture, your Honor indicates when the powder is injected -- on the second page, your Honor.

THE COURT: Yes.

MR. GORDON: The next page.

THE WITNESS: The next page for either top picture is agglomerated alpha nickel powder. And as you can see, your Honor, the flame brightens up.

Q What does it indicate when the flame brightens up like that?

A. That is an indication of exothermic --

THE COURT: Alpha nickel?

THE WITNESS: It is agglomerated alpha nickel.

Q What is agglomerated onto the alpha nickel? What do you agglomerate onto this?

A Fine size aluminum.

You can see, your Honor, that the flame is really brightened up as compared to straight alpha nickel, no aluminum, in the bottom picture.

Q That bottom picture, to you does that show the presence of exothermic reaction?

A No. The bottom picture doesn't indicate any reaction taking place.

The next page, your Honor, the powder is being sprayed, standard Exotec powder, on the top picture. As you can see the flame is also brightened up showing a glaring.

In the bottom picture shows straight nickel -- no aluminum -- nothing -- straight 99 percent nickel.

Q Does that show an exothermic reaction taking place?

A That shows very little exothermic reaction taking place, very little exothermic reaction on Exotec powder.

Q Now, what was common with respect to the tests that you performed as shown in the top photographs and on the second and third pages of Appendix 3?

A What it indicates to me, the reaction -- brightness of the flame, the intensity, and the exothermic reaction that took place was very similar.

Q What is similar in the composition or structure of the two powders being compared in the two exothermic reactions that you see here and here (indicating)?

A Structure.

Q What is the same about it structurally?

A Both have aluminum agglomeration.

Q Fine aluminum?

A Both powders were fine size powders of aluminum agglomerate.

Q What percentage of aluminum are we talking about?

A Both powders have approximately 5 percent aluminum agglomerate.

Q On what?

A With Exotec powder you have nickel -- with nickel lot 165 with alpha-nickel

Q Did you reach any conclusions as a result of the tests which you just described to us?

A My conclusions were this, that alpha nickel doesn't form any exothermic reaction.

Q By itself?

A By itself.

When you spray nickel powder it forms very slight exothermic reaction. But when you spray -- when you agglomerate aluminum with alpha nickel there is a definite exothermic reaction that takes place.

(Continued on next page.)

HS next

S:Pc
ake 5/1

Q I refer you now to --

MR. SPRUNG: I did not hear the last answer.

THE WITNESS: Exothermic powder.

Q Looking at the photographs that appear in appendix 1 of your report, would you describe for us what those photographs are and how they were made -- appendix 1 in exhibit 15.

MR. GORDON: The originals are somewhat clearer. I will have him look at my copy.

A Your Honor, the picture of ~~exothermic~~ Eutectic powder, you can clearly see that this particle -- large particle, is a nickel particle, and the small particles scattered around the nickel particles are aluminum particles (indicating).

Q Is the aluminum in contact with the nickel?

A Also you can see that there is no layer formation of aluminum -- there is no aluminum layer formation and also, aluminum particles are not in physical contact with any nickel particles. This picture was taken in an outside laboratory, wasn't taken at Eutectic.

Q Why were they taken by an outside laboratory?

A Because we do not have the facilities to make very high magnifications. These are 1200 approximately.

Q Yes.

A On the next page also, you can see similar -- this is nickel particle and these are aluminum particles scattered around the nickel particles.

These particles are held in this position by resin which acts as a glue. Also, you can see aluminum particles are also not in physical contact with each other. There is gas between two particles.

Also, your Honor, the third picture -- this would be like a typical -- typical -- like scattered around particles, leaving gaps and leaving gaps between aluminum and nickel particles.

Q Were any analyses made of the coatings that were formed when you sprayed the AMCO powder and the ~~exothermic~~ Atotec -- AMCO ~~agglutinate~~ agglomerated with the aluminum powder?

A We performed -- I obtained sprayed deposits from ~~agglutinate~~ agglomerated nickel powder and also sprayed deposits of exothermic powder. Both powders were analyzed in a chemistry laboratory and the report included to me that sprayed exothermic powder contained .42 percent aluminum.

The agglomerated ~~alcohol~~ alcoa-nickel powder contained .96 percent aluminum --

Q In what form was that aluminum?

A Both aluminums are identified as aluminum oxide by X-ray diffraction.

Q Did your analysis disclose any free aluminum on the coating -- even in solution with the nickel or free?

A Didn't show any degree at all. Did not indicate by X-ray diffraction analysis.

Q Did you compare the bond strengths of these coatings?

A We performed bond strength -- we prepared three from each powder -- three from the exothermic powder and three from the agglomerated aluminum powder. They were tested by -- by an outside laboratory, since we don't have the facility.

The bond strength of both powders are approximately the same -- something like 3,000 PSI.

Q Will you describe the test that is symbolized as Roman numeral 6?

Tell us what you did, what results you saw and the conclusions you reached.

A Aluminum oxidizes, generating tremendous amounts of heat, which softens the exigent particles, so I performed another test using coarse-sized aluminum particles which I sprayed using the Rototec torch.

* * *

Q Would you then summarize for us what conclusions you reached as a result of all these tests

that you have just described for us?

A I reached several conclusions out of all these experiments. Those are indicated in number 7.

Q Would you read those that you consider to be the most pertinent conclusions, and if they are all pertinent, read them all.

A My first conclusion is the only exothermic reaction in the exotec 29904 powder is the reaction of aluminum to aluminum oxide and some nickel to nickel oxide.

Two, aluminum reacts exothermically and generates large amounts of heat.

Third, out of all the possible reactions, the heat formation of aluminum oxide has the most negative values of any of the heat formation reactions.

What it means it generates more -- this reaction from aluminum oxide, and has the highest amount of heat produced by this reaction.

The fourth conclusion, many fine-sized aluminum particles around each nickel particle generates large amounts of heat during reaction which in turn, super-heat the nickel particle.

This super-heated or plastisized nickel particle microweld, or fuse on the work piece.

Q On the substrate?

A Yes, like 1020 steel substrate.

Five, it is also established that most nickel base alloy powder can be made self-bonding material by agglomerating with fine-sized aluminum powder.

Six, there is no inter-metalic phase formed in the sprayed 29904 powder.

Seven, material spherical particles are separated from the nickel particle by the thickness of the solid resin. That is, a thin layer of resin surrounds each nickel particle.

Q You mean nickel particles here?

A Yes.

* * *

Q Now, Mr. Patel, do you know what a clad powder?

A No I don't.

Q You don't know what a clad powder is?

A No.

Q "Question: I refer to Page 8. Do you understa what I mean when I say clad powders.

"Answer: Right.

"Q What is your understanding of the term clad powders.

"Answer: Something sticking on another thing, something sticking together.

"Question: Are you familiar with any work on powders having a core of one material with a cladding or coating?

"Answer: That I understand."

I would like to show you exhibit IS. Can you identify that document?

A Yes.

Q Is that a patent where you are named inventor?

A Yes.

Q What is the title of the patent?

A "Ceramic Clad Flame Spray Powder."

Q And do you know what the term clad flame spray powder means as used in that patent?

A No I don't.

* * *

Q All right, you are familiar with exotek powder. And what was your understanding of the composition of exotek powder?

A The 5 percent combining aluminum with 95 percent nickel.

Q Now you have a nickel nucleus or nickel core in the exotek powder?

A In the exotek powder fine-sized aluminum is scattered around nickel.

Q You have a nickel core, is that correct?

A I don't understand the "core".

Q You don't understand what core means?

A At this point, yes.

Q You have a particle of nickel -- do you understand what particle means?

A Yes.

Q And is that particle coated with a resin?

A It's coated with resin.

Q And in that resin are embedded fine particles of aluminum?

A The aluminum particles sticking on the resin.

Q Yes, are they in the resin?

A They are in the resin.

Q Are the aluminum particles bonded to the nickel

10 with the resin or stuck to the nickel with the resin?

A Glued to the nickel, yes sir.

* * *

Q Now, you say the purpose of the Exotec powder is as a bonding powder, self-bonding powder.

A That's right.

Q And what does that mean to you?

A What it means, that the -- when you spray Exotec powder --

Q Yes.

A -- the heat-softened particles fuses or microwelds with the substrate.

Q In other words, it tenaciously sticks to the substrate, is that right or don't you know?

A I am not familiar with tenaciously.

Q Okay, I will try. Bear with me. And it's purpose is to make the coating stick or something else is sprayed on top of it usually in the recommended use of the Exotec powder. Do you understand what I mean?

A Say that again, please?

Q Is another flame spray powder generally sprayed over it, the Exotec?

A That's correct.

Q In other words, they spray it on and then they spray another material over and the purpose is to bond the other material, is that correct, sir?

A That's correct.

* * *

Q No, whether the resin has a function in keeping the aluminum and nickel together as a structural unit when it goes into the flame so that the powder will be a self-bonding powder.

A Whether the resin has any function?

Q What?

A The resin has any function?

Q Any purpose.

A My contention is that you have resin to make it flow.

Q I see, and the resin, in other words, if you just mixed loose aluminum powder --

A Right.

Q (Continuing) -- and the coarser aluminum powder, just as --

THE COURT: Coarser nickel, don't you mean?

Q I'm sorry, coarser nickel powder, in other words, just mix nickel -- you understand what I mean by a mixture of powder?

A Yes.

Q What is a mixture of powder?

A Just mixed together.

Q In other words, the particles are loose from each other?

A Right.

Q And in the Exotec material, they are not loose from the others, the aluminum is bound on to the surface of the nickel; right?

A That's correct.

Q So if we had just loose, it would work just as well except you might have a problem of closing the gun; is that correct?

A That is -- that 's correct.

Q All right. That's what I wanted.

A That's correct.

Q In other words, you feel that the powder would bond as a mixture just as well.

Have you ever tried spraying a mixture of nickel and aluminum powder?

A Yes, I did.

Q And they are self-bonding?

A When I tried to spray just the mixture, it will not flow.

* * *

HS:pc
take 7/1

Patel - cross/Sprung

Q You do not know, okay.

You said a microscopic investigation of self-representative particles showed that the aluminum particles are not in physical contact with the nickel particles -- aluminum particles due to the dry resin layer around the nickel particles.

Do you base that on the photographs?

MR. CALIMAFDE: Do you understand that question? Could you base that on the photographs is the question?

A I base it on two things that the aluminum particles have to ~~strike~~ ICK. on something, so the only thing you have is the resin and the second thing I observed under the microscope -- on two bases I made a conclusion like that.

Q Would it be possible for the aluminum particles to be right in contact with the nickel and resin over it?

A It is not possible.

Q Why is that?

A The resin layer, they are loosely floating. When you add resin it stops beginning to stick around it --

* * *

THE COURT: All right.

Q You say that the resin has to coat the nicke core and thus the aluminum cannot be in direct contact with the nickel?

A That is one observation.

Q All right, one.

Now, how close, in your estimation, could the nickel get to the aluminum?

A Approximately one to two microns.

Q What distance is shown between the particles in specimen 2463 and --

A What distance?

Q Yes.

A Which particles?

Q The closest particle.

A Your question is which aluminum particle is closest?

Q What distance is shown between the aluminum particles that are closest to the nickel?

A What distance?

Q How close are the closest nickel particles to the closest aluminum particles?

You have measured these distances, some of them, and put them into your report?

A Right.

I am sorry. I have difficulty understanding.

MR. CALIMAFDE: He wants to know the closest distance between the aluminum particles and the nickel particles?

THE WITNESS: The closest distance is in this particle that you are talking about, probably from here to here (indicating.)

Q Can you give me an estimate?

A I need a ruler in millimeters.

Q Yes, the metric is on the bottom (ruler handed to witness.)

A Yes.

I can't measure. This is small magnification.

Q I see.

Is there another sample that you could measure?

A Yes --

Q We are referring now to 694M magnification 1200.

Let's take that distance.

A That I cannot measure either.

Q In other words, it is not a measurable distance on that photo?

A Under a microscope you can.

Q I see.

Let's take -- you can't measure the distance with a ruler at one thousand two hundred?

A This distance are measured under a microscope.

MR. CALIMAFDE: He said he cannot measure the closest distance, is what he said.

Q Which of these particles would you say would be an average distance away?

A There I cannot tell you from this picture, I need a

microscope.

Q I see.

Just for the record's sake, what is your estimate of the resin itself -- the thinnest resin layer that you could get on the particle?

A One micrometer, two micrometers.

Q It is estimated that the resin at the bottom of your report, the resin layer which separates the nickel and aluminum particles, is one micron to two microns thick?

A Correct.

Q That you measured on a microscope?

A Yes.

Q From the particles or from the photograph?

A From the particles.

* * *

Q And do you base some of your conclusions that you draw from that time interval?

A The time interval here -- let me see.

Actually, the particles remain inflamed less than one microsecond because the particles travel like 800 feet per second.

Q Now, you say the following changes take place in the particles in the one to two microseconds; is that correct?

A That is correct.

Q All the resin has to burn up in smoke?

A That is correct.

Q What?

A That is correct.

Q Okay.

Since the resin burns first, it retards any contact between the nickel and aluminum?

A That is correct.

Q Would the resin also retard contact between

aluminum and oxygen?

A No.

Q I see this retards contact between Nickel and the aluminum, but it wouldn't retard contact with the oxygen?

A No.

Q Can you tell me why?

A Because oxygen atoms are very small -- extremely small, even to an aluminum particle.

Q It gets through the resin?

A Aluminum has a high chemical affinity --

Q The resin would not protect the aluminum from oxidation?

A Where?

Q Well, let's start when the resin is on the aluminum until it burns off the aluminum.

A If resin is around aluminum, then it might protect.

Q Then it means the aluminum could not oxidize until the resin is burned off; is that correct?

A That is not correct.

Q Until the resin started to burn off?

A As soon as resin burns it opens up and burns and smokes -- as soon as it opens up. That is ample contact with the oxygen.

Q According to your understanding of the Exotec powder, you have nickel core with the aluminum on

the resin on the outside and when you flame spray it the aluminum undergoes an exothermic reaction; is that correct?

A That is correct.

(continued next page.)

Q It heats the nickel particle with this exothermic reaction and makes it nickel self-bonding; is that correct?

A That is correct.

Q If you didn't have this exothermic reaction would the material be self-bonding?

A It depends upon the heat source. If you spray -- this is my belief -- if you spray with the plasma gun, you'll get self-bonding with nickel.

* * *

Q Are you familiar with flame spray powders that are composites which contain unreacted nickel and aluminum with five per cent aluminum? Are you familiar with such powders?

A Yes.

Q Are they referred to as nickel aluminide powders, also?

A Metco 450 powder is referred as nickel aluminide powder.

Q This powder you flame sprayed in what kind of gun?

A Rototec.

Q In a plasma gun?

A No, sir.

Q This is the gun manufactured by the plaintiffs.

You used the term alpha aluminum -- alpha nickel. When did you first become familiar with that term as used in connection with this type of powder?

A Very recently.

Q Very recently?

A Right.

Q Between the time your deposition was taken and this trial?

A That is correct.

Q During your deposition, you referred to the powder as pre-reacted nickel aluminide powder?

A That is correct.

* * *

Q Then, as I understand it, you took this material, the P66 and coated it with additional aluminum powder; is that correct?

A That is correct.

Q So that it was basically the same as Exotec powder instead of having pure nickel as the core, it had the nickel aluminide 95/5 or the P66 as the core or the alpha nickel as you want to call it, right?

A (No response.)

Q Is that correct?

A That is correct.

Q In other words, exotec powder instead of pure

nickel and nickel which has already reacted with 5 per cent aluminum in it; is that correct?

A That is correct.

Q You sprayed that powder and was it self-bonding?

A After I had an agglomerate --

Q When you say agglomerate, you mean forming in the same form as the Exotec?

A That is correct.

Q Then it was self-bonding?

A Then it was self-bonding.

Q That indicated to you what?

A That indicated to me that aluminum reacts to aluminum oxide which superheats the alpha nickel particle and which fuses onto the work piece.

(continued next page)

* * *

MR. SPRUNG: Your Honor -- I'm -- the question was, when he converted the P-69 to a form similar to Exotec. In other words, took the P-69 and coated it, whether that was self-bonding.

THE WITNESS: That I found self-bonding.

Q What was the bond strength of that material?

MR. CALIMAFDE: Bond strength?

MR. SPRUNG: Yes.

Q Did you measure the bond strength?

A I measured bonded particles.

Q Did you measure th bond strength?

A No, I did not. I did not have time.

* * *

Q The same amount.

And do you have samples of both of those materials as sprayed?

A I'm -- as I'm looking here, Mr. Sprung, that I --

Q I see it says here AL plus P. P-69?

A No. That is straight P-69.

Q It says on the front AL plus P-69?

A That's wrong.

(Continued on next page.)

Notes follo

GR/rp
AMR2

1 Patel - cross - Sprung

CROSS-EXAMINATION

BY MR. SPRUNG (Cont'd):

Q What does that mean?

A This is straight powder coming out from P69.

Q What is the AL plus P69 mean?

A That means normal.

Q That is an error?

A Yes.

MR. SPRUNG: Could we mark this?

MR. KRAMER: KP.

MR. SPRUNG: As a Defendant's Exhibit.

* * *

THE COURT: I mean, these are steel, sprayed steel samples?

THE WITNESS: That's correct, your Honor.

THE COURT: With P 66 or P 69?

THE WITNESS: Straight P 69.

THE COURT: Straight P 69.

3 Patel - cross - Sprung

BY MR. SPRUNG:

Q So this is a steel plate and this is the P 69 coating, which peels off; is that correct? It is not self-bonded?

A Let me explain. This is the steel plate, your Honor, and you clean up the -- and this -- you heat it up.

THE COURT: All right. Then you spray on and you get the other?

THE WITNESS: The other.

THE COURT: But it didn't stick?

THE WITNESS: That didn't stick. That indicates it is not a self-bonding material.

THE COURT: All right. That's straight P 69?

THE WITNESS: Straight P 69.

THE COURT: And that's exhibit now what?

THE WITNESS: KP.

THE COURT: KP.

BY MR. SPRUNG:

Q How thick a coating is that, do you know, that was sprayed?

A That was sprayed ten thousand -- six to eight thousandths thick.

Q Six to eight thousandths mils?

A Six to eight mil.

Q Yes. Six to eight mils. Okay.

Now, show us P 66, which was sprayed by itself?

A Yes.

Q And that is also not self-bonding?

A Also not self-bonding.

Q All right.

Now, do you have P 69 agglomerated with the aluminum powder so as to coat the particles?

A I'm sorry. I don't see it here but I can --

Q With -- all right. Do you have the P 66?

A Yes. This is aluminum agglomerated with P 66.

* * *

Q And in your understanding, how much bond strength would a self-bonding material have?

A Self-bonding material, should have minumum, 2000. That's my understanding.

* * *

AFTERNOON SESSION

Q Now, do you have your -- as part of Plaintiff's Exhibit 15, there is a memorandum of November 17, 1973 to you from Mr. Brachfeld. Would you turn to that?

A The last one?

Q Yes.

A Okay.

Q Now, it says in the introduction that, "As is well known, the original theory behind the NIAL bonding mechanism was that in flame spraying AL combines with nickel to form the intermetallic ~~NIAL~~ NiAl."

Was that the theory that was believed to have

occurred at Eutectic when you first arrived there?

A I don't know because this -- Mr. Brachfeld must have known before, prior to my joining.

Q It says then, "A new theory was proposed by M. Patel."

A That's the theory I proposed to them.

Q Are you the "M. Patel referred to?

A Yes.

Q Now, when did you propose this theory, do you recall?

A I believe I -- I --

Q When did you propose it?

A April or May, '72. After receiving film report.

Q In other words, you proposed this new theory in around April, '72; is that correct?

A '72, yes.

Q All right.

Had Eutectic been manufacturing and marketing the exotec powder prior to that? Prior to that date? That you produced this new theory?

A Yes.

Q They had?

A Exotec powder?

Q Yes. Was it used as a bonding coat?

A Yes.

* * *

Q Did you work in Metco, do work in developing either the Metco 404 or Metco 450 powder?

A No. I never worked in development of Metco 450 powder or Metco 404 powder.

Q Did you ever spray either the Metco 450 or the Metco 404 powder while you were working at Metco?

A Never sprayed any powders. Generally speaking, powders were sprayed by technicians.

Q Never sprayed any powders at Metco?

A Never sprayed any powders.

Q At the time you left Metco, to your best recollection, did you know the compositions of either the Metco 450 or the Metco 404 powders?

A According to my best recollection, when I left Metco, I had forgotten or I never remember actual percentage of composition of Metco 450 powder or Metco 404 powder.

* * *

Q Began working in Exotec in October, 1971. In the period between December, 1970, and October, '71, were you ever asked by anyone at Eutectic

about the compositions or manner of manufacture of the Metco 404 or Metco 450 powders?

A First of all, I never knew how they manufactured Metco 404 and Metco 450.

Q My question is, were you ever asked at Eutectic --

A But nobody ever asked me about the composition or manufacturing matter or whatever about these two powders.

Q Did you ever offer any information yourself on the composition or other information?

A No.

Q Of these powders?

A No.

* * *

3 gr/nc

I offer for identification a bottle of the blend that Mr. Patel has discussed, as Plaintiff's Exhibit 77.

THE CLERK: 77 for identification.

(So marked.)

MR. GORDON: And the steel plates identified on the back as Blend 5 Al plus 95Ni, as Plaintiff's

xxxxxx

Exhibit 78.

THE CLERK: 78 for identification.

(So marked.)

BY MR. GORDON:

Q Now, was the coating that you obtained a self-bonding coat?

A That's correct.

Q Now, and on what do you base that statement? I hand you Exhibit 78.

A I used the same shrink test that I described before. And when I shrink the coating, I saw almost 70 percent bond particles.

* * *

Q Have you correlated that with other materials other than the Exotec material; in other words, what I'm asking, have you taken the material, sprayed it, noted the percentage of particles that stuck and then had a tensile bond strength test made, saw if that correlation applied

to materials other than Exotec?

A No, I did not do that.

* * *

Q If the request for a consumable or a powder required a hard facing application, was there a class of metals which was known to have these properties from which you would select your ingredients?

A Yes.

Well, originally all of our systems were nickel base.

Q Why was that? Why were your systems nickel base?

A They primarily were nickel base because nickel, to begin with, is a ductile material, with additions of boron and silicon.

These alloys, the melting point of the overall system is depressed, so that they can be applied in the field at relatively low temperatures, when compared with other processes, such as that of welding.

Nickel is a very compatible material, when applied on many, many types of parent materials we will find in industry and in the field.

Now, later, of course, in our development work, we found need, particularly from a heat and corrosion point of view, a demand for what we metallurgists describe as stellite-type materials, and those would be the grades, such as Stellite 1, Stellite 6 and Stellite 12.

Internally, and of course, later in sales and in marketing, we describe three of these products as Eutallite powders.

Q Before we go off into that area, Mr. Quaas, you mentioned that nickel was a compatible metal. What does that mean?

A It's a material which, as I think I mentioned before, is ductile by nature. It naturally alloys quite well with numerous parent materials. Iron or steel is one of them.

And if nickel is applied or a nickel base alloy is applied to steel parent material, for example, or a ferrous base material, in fact over an extended length or period of time at a specific elevated temperature, one can actually get the fusion of nickel into the substrate, into the parent material.

Q And nickel is known to have this property, was it not, prior to 1962, when you --

A Yes.

* * *

Q Does Eutectic continue to sell the Eutalloy consumables or powders?

A Yes.

Q Do you know the process for applying the Exotec powder?

A Yes, sir.

Q Does Eutectic recommend any preparation of the base metal preliminary to receiving the Exotec coating?

A Yes, we do.

Q I'll show you what is called Product Data Guide, entitled the cold process, Roto-Tec, product data guide, and ask you whether you can identify it?

A Yes, I can.

Q Does that describe the treatment to be given to the base metal before receiving the Exotec powder?

A Yes, it does.

Q All right. What treatment is recommended for the base metal,preliminary to receiving the Exotec coating?

A Cleanliness is next to godliness. Depending upon the application, we much prefer, initially, if it's a shaft, for

example, to prethread the shaft before deposition of the Exotec.

Q You said, "pre-thread?"

A Prethread.

Q So if you had a smooth shaft, the recommendation is to cut threads into that shaft?

A Exactly.

Now, we --

Q Why?

A We recommend this operation because a threaded area naturally will present much more surface area for attachment of whatever alloyed powder is sprayed upon that member later.

Q Is there any other preparation recommended for the base metal?

A Yes. Prior to application -- prior to spraying of the powder consumable, the parent material we recommend, should be preheated to approximately 200, 300, 400 degrees Fahrenheit.

* * *

Q Now, based on those results, do you wish to confirm or amend the answers you gave in the deposition regarding the nature of the exothermic reaction?

A I agree wholeheartedly that there is an exothermic reaction. I disagree with the fact that there possibly is a direct reaction with the aluminum, directly with the nickel.

Q What, in your opinion, is the nature of the exothermic reaction?

A With the information now at hand, it's my opinion that the aluminum component does react with oxygen and it is that reaction which affords the great liberation of heat content which of course is transferred to the nickel particle and provides self-bonding characteristics.

Q And when you use the expression, "powder," you are referring to the 95-5? The Exotec powder; is that correct?

A Yes, that's true.

Q Mr. Quaas, you testified on your direct examination that in 1962 Eutectic started manufacturing and marketing a series of spray materials under the general designation, Eutalloy; is that correct?

A That's correct.

Q In applying the Eutalloy materials to a sub-spray surface or base, was it required that this base be heated to the fusion temperature of the powder, melting temperature?

A Yes, sir.

Q Was the bonding dependent upon heating the base to this high temperature?

A The bonding was dependent upon the self-fluxing characteristics and the overall melting point of the alloy powder being deposited.

Q If we took -- let me ask you first: What type of materials did you generally use the Eutalloy process on, steel shafts?

A No.

Q What?

A Steel shafts, of course, war one application, but when I considered the broadness of the marketing area, I think that many, many applications were other than what I would call round or rotating para-material members.

Q What were they generally made of?

A I think I indicated previously orders, building up the lips, extrusion, multitude of farm implement applications.

Q If we took one of the standard surfaces that you normally would apply a Eutalloy coating on by the Eutalloy process and say pre-heated it to 2- or 300 degrees, in Rototec, how high do you heat it, 2- or 300 degrees?

A Yes.

Q Is that Fahrenheit?

A That's correct.

Q Suppose we heat the surface to 2- or 300 degrees and just sprayed the Eutalloy nickel base self-fluxing alloy on it, would the material adhere?

A The material would adhere, but it's my opinion that the integrity of the bond would be not satisfactory.

Q In other words, you wouldn't get a satisfactory bond?

A That's right, unless subsequently that applied material was fused.

Q By fused, you mean heating it and the base up to near-melting temperature?

A Up to near-melting temperature of the allow powder applied, not the melting temperature of the parent material.

Q About what temperature would you have to heat the base?

A Somewhere between 18- and 2,000 degrees Fahrenheit, depending upon that alloy system being used.

Q The Eutalloy process, is that sort of a welding process?

A It's a brazing process.

Q Would you explain to his Honor what you mean by a brazing process.

A Welding, as I know it, is a process where we would weld material, when applied to the parent material stock. Actually, will melt part of the parent material; so that under the circumstances, a certain amount of what we call dilution effect is experience.

In applying a Eutalloy type consumable, we do not obtain any such dilution effect; nor do we in any way approach the high temperature that are experienced in a so-called welding operation.

Under those circumstances, we refer to that type of process as a brazing process. A brazing process to me is one which when utilized will not melt any portion of the parent material.

Q Do you consider the Rototec process a brazing process?

A No.

Q Would you distinguish between the Rototec

process and the Eutalloy process which makes the Eutalloy brazing and the Rototec not a brazing process?

A The Rototec process is one as we have pointed out before requires pre-treatment of some sort relative to the parent material before any powder is applied.

I testified earlier that grit blasting and/or threading is a desirable pre-treatment in order to, in effect, obtain good bonding integrity and, of course, the powder is applied, again, as we have discussed previously at a relatively low pre-heat temperature in terms of the parent material, but that pre-heat temperature depending upon the nature of the beast being in the area of two, three, four, sometimes even 500 degrees Fahrenheit.

At that point then a compatible powder consumable -- let's say a bonding-type consumable will be applied.

Later, depending upon the specific requirements of that given application, another coating will be applied over the so-called bond coat.

Q Have you ever heard of the term "cold process," applied to the Rototec process?

A Yes.

Q Does that mean to you that the base material on which the spraying is effected is maintained at a relatively cool temperature?

A Correct.

Q As opposed to this, the Eutalloy process is a hot process in that the basic material is heated up to brazing temperatures?

A On a relative basis, yes.

Q You testified that the Eutalloy consumables, the spray powders, were self-fluxing; is that correct?

A Yes, sir.

Q When does a self-fluxing action come into effect? In other words, would it come into effect if I simply sprayed the Eutalloy material on a relatively cool or cold surface?

A To a minor extent, yes.

Q Would that cause any degree of bonding of the Eutalloy to the base.

A Yes.

Q Would that form a satisfactory bond?

A Not in my estimation.

Q Pardon me?

A Not in my estimation.

Q It would not.

When you heat the base to the brazing temperatures, then the self-fluxing characteristics do cause a bond?

A Yes.

Q In the Eutalloy process, you say, you started

in '62. When did you start promoting the Rototec process?

A I believe in '70.

Q 1970?

A Right.

Q Prior to 1970 and after you started the Eutalloy process, was Eutectic engaged in the marketing or promotion of any consumable powders to be sprayed by the cold process?

A Yes.

Q Would you designate what those materials were?

A We have developed, prior to the Rototec process, a process which we called SPRAM. In fact, the Spram torch was really the forerunner of the Rototec torch design.

We had developed the Spram process for, particularly, applications in the glass mold industry. The Spram process is and was a process by which was considered a two-step method of application.

Powder consumables would be applied to glass molds or glass mold components with low pre-heat temperatures being employed. The powder would be sprayed and then later fused either with the Spram torch itself, which was oxyacetylene device, to provide the necessary heat for fusion or exterior torch.

Q What was the difference between the Spram consumables, the powders, the spray powders and the Eutalloy

powders?

A Basically, the Spram consumables were very, very similar to the Eutalloy type in that they were possessed of self-fluxing characteristics.

Q Basically, what you call in the trade hard facing, nickel base self-fluxing alloys?

A Yes.

Q As to the Spram materials, when they were initially applied, prior to the fusion step, were they applied by a cold process?

A I mentioned before, I said, with low heat, pre-heat.

Q Would, in your estimation, the application of the materials at these lower temperatures produce a sufficient bond between the sprayed material and the base, as sprayed on for most uses?

A No.

(Continued on next page.)

-pm#2
SS/elc

Q It will not.

And the fluxing materials that were present in the Spram materials at these lower temperatures would not act to form this high degree of bond which was necessary?

A That's right, without the fusing step.

Q Without the fusing step.

And the Roto-Tec process, do you spray materials other than the Exotec material as a final coat?

A Certainly.

Q Give me an example of such a material.

A The one I mentioned previously, identified by us as 19910.

Q What is 19910?

A 19910, as I recall, is a powder consumable consisting of approximately ten percent of the nickel aluminum powder plus 90 percent of a nickel base self-fluxing type alloy powder. It's a heterogenous mixture of the two powders.

Q Apparently, I have not worded my question correctly. What I'm interested in knowing, in the Roto-Tec process, do you have spray materials that do not contain the nickel aluminum composites as a final coat?

A Internally, we do. We have specific powder consumables that have been developed that have not been released for sale.

Q Maybe I still haven't. In the Roto-Tec process you normally spray an Exotec and then you spray a material over that?

A Correct.

Q A material that you spray as the final or overcoat, does that contain a nickel aluminum composite?

A Only one.

Q Do you spray materials which do not contain a nickel aluminum composite?

A Yes, sir.

Q What materials?

A There's aluminum-bronze type.

Q Let's take the aluminum-bronze type. If you spray that directly without initially spraying the bond coat, do you, in your opinion, believe you would get a reliable bond?

A With which process?

Q Roto-Tec.

A No.

Q You do not.

So, the purpose of the Exotec or Xuperbond is to ensure a reliable bond; is that correct?

A Correct.

Q This is in spite of the fact that you initially

3 Quaas-cross

thread, clean and thread the surface on which it's sprayed?

A Right.

Q If you spray the normal overcoat materials which do not contain the nickel aluminum composites on the prepared surface, you get some sort of mechanical bond?

A Possibly.

Q Possibly, mechanical.

If you spray the Exotec material or the Xuper-bond material, then you not only get a mechanical bond, but some sort of metallurgical bond; is that correct?

A Yes, sir.

Q That is without the fusion operation?

A Yes, sir.

Q That's in the cold process?

A Yes, sir.

Q Do you have available on the market any other materials other than the nickel aluminum composites which will form this secure bonding coat? At Eutectic?

A No, sir.

Q You do not.

Would it be feasible for you to promote and market Roto-Tec processing equipment and materials without the Exotec or Ruperbond, nickel aluminum composite-type materials?

4 Quaas-cross

MR. CALIMAFDE: The question is broad and vague.

MR. SPRUNG: I'll rephrase the question.

BY MR. SPRUNG:

Q You have two bonding materials that you market at Eutectic; is that right?

A Right.

Q One is Xuperbond. The other is Exotec. If you do not have Xuperbond or Exotec, would it be feasible for you to promote the Roto-Tec process and market equipment and consumables under it?

MR. CALIMAFDE: I'm afraid I don't understand that question.

BY MR. SPRUNG:

Q Do you understand my question?

MR. CALIMAFDE: The reason I don't understand it, your Honor, is because --

MR. SPRUNG: Let's see if the witness understands.

MR. CALIMAFDE: If I don't understand, I don't want my witness to answer it. It must be understandable in the courtroom.

If you're using "feasible" to have a marketable process, you're so broad it is not

a fair or understandable question. Are you including the plasma gun, metal system?

The question is so broad it cannot be answered intelligently, in my view.

BY MR. SPRUNG:

Q Do you believe you can answer that intelligently?

A Mr. Sprung, I would like you to repeat the question.

Q Do you believe that you would have a commercial process and product which you can market as you do Roto-Tec if you did not have the Exotec or Xuperbond type coat materials?

A Yes, I think so.

Q What would you use in place of those materials?

A Molybdenum.

Q Do you believe by spraying a molybdenum powder you can get a satisfactory bond coat?

A I think so.

Q Have you ever tried it?

A Let's get back to the prior question.

With what process?

Q Roto-Tec, I'm talking about.

A No.

Q In other words, you're changing your original answer?

A No. I said yes, we could have, in my opinion, a marketable process, but I could use molybdenum as a bonding material, but not applied with the Roto-Tec torch.

Q What would you have to do?

A I would presumably apply it with either the plasma process. I'm talking about the molybdenum or with the wire process.

Q You say the plasma process. What is the market-how much does a Roto-Tec gun sell for on the market, retail price?

A I am guessing, I'd say $400 or $500.

Q $400 or $500.

Do youhave any idea what a plasma gun, one of the most inexpensive plasma guns, cost?

A Are you talking non-transferred arc or transferred arc?

Q Non-transferred arc.

A With a power source?

Q Yes.

A I would say -- I'm guessing, the cheapest one would be in the area of $5,000.

Q So that if someone had a, say, $5,000 piece of

7 Quaas-cross

equipment, they could spray molybdenum as a bond coat and use your Roto-Tec to spray over it?

A Correct.

Q Or they wanted to spray with the wire gun first, the molybdenum coat, then they could spray with the Roto-Tec process?

A Yes.

Q How much is the most inexpensive wire gun cost? Have you any idea?

A Not really.

Q You don't?

A No.

Q Do you at this time market a plasma gun or wire gun -- I'm talking Eutectic when I talk to you.

A We do not market a wire gun for metal spraying purposes. We do market a transferred arc plasma setup.

Q COuld you spray a bond coat with this transfer arc?

A No.

Q You could not.

So, then, at present, Eutectic has no equipment by which they could spray a bond coat other than the nickel aluminum composites; is that correct?

A Yes, sir.

8 Quaas-cross

Q Is the Roto-Tec process promoted and marketed as a complete process? When I say, "complete process," a process in which you tell the customer, "You can buy our torch and you can spray a satisfactory coating with it for many repair purposes;" is that correct?

A Yes, sir.

Q Could you do that if you did not have the nickel aluminum composite self-bonding powders?

A No, sir.

Q During your direct testimony, Mr. Quaas, you were read a portion of your deposition where you stated that you believed that the nickel and aluminum reacted to make an exothermic reaction in the Exotec material and that your opinion has now changed?

Would you tell us what knowledge or information you have gained other than the Patel report?

Are you familiar with the Patel report?

A Yes, sir.

Q Either --other than the Patel report on which you changed this basis of opinion?

A No.

Q It's solely based on the Patel report?

A Yes.

Q Mr. Quaas, what's your understanding as one

familiar in this art of the term, nickel aluminide?

A What is --

Q Your understanding of the term, nickel aluminide, as it's used in the flame spray field?

A In my estimation, it's a rather loose term that has been applied to bonding-type consumables.

(continued on following page)

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4/3

Q Is it any combination of nickel and aluminum?

A Nickel aluminides, again, I repeat, in my estimation, is a loose term, and yes, it's applicable to any range.

Q Any range of nickel?

A Components.

* * *

Q Mr. Dittrich, did I not ask you the following question and did you not make the following answer, beginning at line 8:

"Question: What powders were you familiar with in that period, between 1945 and 1955, that were suitable for flame spraying?

"Answer: The requirements of powder spray at the time were not very great. The principal use of powder spray equipment during that period was in spraying zinc coatings."

Now I should like to stop there.

When you answered, "The requirements of powder spray at that time were not very great," what did

you mean?

A That the scope of the process appeared to be quite limited.

Q Now you say, "process," sir. Do you mean powder?

A Powder spray.

Q Now, when you say, "quite limited," would you explain what you mean by that?

A Yes. In those early days, as I recollect, what we knew the powder process was primarily used in spraying zinc for correlation-resistent coatings. This is one of the primary areas.

Q Primary area of the powder for metal spraying was a zinc powder for coatings?

A I believe, as I recollect that time period, that this was the predominant material that was being sprayed at the time.

Q And now we are talking about the period between '45 and 1955?

A Right.

* * *

Q All right.

But let me discuss that with you for a moment.

But let's establish first, did METCO manufacture a powder gun for commercial sale through the period of 1950 to 1955?

A No, sir, we did not.

Q Did METCO sell any powders through that same period, 1950 to 1955?

A No, sir, we did not.

* * *

Q So that the powders which you recall in existence prior to 1955 were the zinc and the hard-facing, self-fluxing alloys; is that correct?

A Yes. And I believe I also mentioned previously that Schori did spray aluminum powder.

Q And that Schori sprayed aluminum powder?

A Yes, sir.

Q Is that the extent of your knowledge of the

powders which existed in 1955?

A Wall Colmonoy, if my memory serves me correctly, offered -- I can't be sure of this, but as I recollect it, Wall Colmonoy offered a couple of other powders. I believe they were stainless steels, but again I am not sure.

Q Now, as of this time in 1955, you personally recall of any problems that anyone was having with these powders?

A Yes. I believe Wall Colmonoy had problems in spraying aluminum with this particular piece of equipment. That is, -- I'm sorry. Did I say Wall Colmonoy?

Q Yes. Did you mean Schori?

A I meant Schori.

Q Do you recall that Schori had trouble spraying aluminum powder?

A Aluminum powder were their particular piece of equipment. I don't recall specific problems that Wall Colmonoy might have had, although my familiarity with their equipment, of course, was only through the work we were doing. I don't know if they might have had problems that I didn't know about.

* * *

Q When did spray equipment becoma commercially available for spraying powder? And by commercially available, I am now referring to the type of gun which could spray powders other than the zinc or the hard-facing, self-fluxing alloys. When did those guns become available for spraying powders?

A Let's see. I believe it was in 1956, when we put our first powder gun on the market.

Q What did you call that powder gun?

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A It was a thermo spray type, P was the original.

THE COURT: Thermo spray?

THE WITNESS: Thermo spray, yes, your Honor.

Q You call that a model P?

A Model P. Type P, Model P, yes.

Q Is it fair to say that the development work on powders, therefore, did not begin until there was adequate equipment on the market for spraying powders?

A I don't believe I understand your question.

Q Is it fair to say that the development of powders for metal flame spraying awaited the development of guns which were suitable for spraying these powders? Is that correct?

A Well, when we put our first gun on the market, which as I say I believe now is about 1956 or so, we put on the market at the same time a series of powders that we had worked with and developed that were useful in that thermo spray gun.

Q Is my statement a correct one, Mr. Dittrich, that prior to the production of powders, there had to be, of course, guns for spraying those powders? Isn't that true?

THE COURT: Do you understand what he is driving at?

THE WITNESS: I'm not quite sure that I do.

THE COURT: Well, I suppose one might say it's something like the chicken before the egg idea.

MR. CALIMAFDE: Yes.

THE WITNESS: Well, I gather then that you mean that before other people would develop powders for spray gun, there had to be a spray gun on the market that would spray powders?

(continued next page)

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DIRECT EXAMINATION

BY MR. CALIMAFDE (Cont'd):

Q Well, I guess I'm looking --

A I assume that this is what you mean.

Q I guess I'm looking for an acknowledgement of a truism, that before you develop a powder, you must have something for spraying that powder and in your case, in the Metco case, you came out with your gun and your powder at the same time?

A Right, sir.

Q All right. That was about 1956?

A That would be about 1956.

* * *

Q In fact, Metco did not manufacture a powder for sale until much later in the decade of the 1950's, if at all; isn't that true?

A At that time, we were not manufacturing the powders per se. Let's see. I believe at that time we were doing internal size classification. That is, to limit the ranges of powders and take out undesirable sizes.

* * *

Q Mr. Dittrich, prior to 1968, you had no knowledge of other companies working or experimenting with nickel aluminum plastic bonded wire for powders?

A No other companies, no sir..

Q And you had no knowledge that anyone in the field was attempting to produce a powder having improved bonding characteristics prior to 1960?

A No, sir.

* * *

Q Do you recall that the aluminum powder which you sprayed reacted exothermically with the oxygen?

A I suspect that there was some oxidation, as there is with all the materials that are flame sprayed, be they wire or powder spray.

Q When you say oxidation, you are using that word to include exothermically; is that what you mean by oxidation?

A Oxidation is an exothermic reaction.

Q If an exothermic reaction occurred you would see it visibly, would you not?

A Possibly.

Q Isn't an exothermic reaction one in which the aluminum powder tends to flame?

A Yes, I suspect it would. It was a degree of oxidation. That is if the powder for instance were being sprayed at a lower temperature flame you would see less oxidation, and at a high temperature flame you would see more.

Q Mr. Dittrich, so that we understand each other and the record is consistent with what we are expressing to each other, when you use the word oxidation, do I understand you are talking about an exothermic reaction with the oxygen and that is what you mean by oxidation?

A I repeat, oxidation is an exothermic reaction.

Q When the aluminum was sprayed, it reacted with the oxygen exothermically?

A Again, it is a matter of degree. There was some oxidation of aluminum, but in essence what we developed was an aluminum coating perhaps with oxide boundaries, very, very thin oxide films.

* * *

DIRECT EXAMINATION

BY MR. CALIMAFDE: (cont.)

Q Mr. Dittrich, it is a fact, is it not, that Climax suggested the use of nickel and aluminum as a spray powder for their work?

A Now I'm not at all certain that they did.

* * *

Q At the top of the page did I not ask you to following questions and did you not make the following answers:

"Question: And was it also a part of their project" -- that's the Climax project -- "to coat the molybdenum with nickel aluminum to form nickel aluminide?"

And your answer, "This was one of the many materials combinations that they had under consideration at the time and with which I sprayed for them at the time."

A Right.

Q All right. Now, you made that answer to that question.

Now, was your function, sir, merely to apply the coating?

A At that time, it was.

Q And was the purpose -- pardon me?

A The --

Q If you can answer it yes or not, maybe we can get this true.

Was your purpose to spray the coatings?

A Primarily.

(continued next page.)

DIRECT EXAMINATION

BY MR. CALLAFEO (Cont'd):

Q Was the purpose in spraying nickel and aluminum to obtain nickel aluminide?

A I -- that would have to be an assumption on my part.

Q Was the purpose in spraying nickel and aluminum to obtain nickel aluminide because of the -- of the desirable properties which nickel aluminide had?

A Yes. Climax Molybdenum was trying to --

Q The answer is yes. Let me see if we can do it that way; right?

I'm trying not to tax you and --

A I know. I'm trying to keep it short myself. But with most of these questions, a simple yes or not doesn't answer the question completely and fully. And this is my problem.

Q Let me see if I can frame my questions to you so that a fair yes or no is possible.

Were the properties, known properties of nickel aluminide essential to the product which you worked -- you were spraying, namely, the property of high temperature oxidation resistance.

A The properties of high oxidation resistance were

the properties that Climax Molybdenum were looking for at the time, in order to protect their Molybdenum substrates from oxidation in the high temperature oxidizing.

Q They were looking for nickel aluminide because of this property; is that correct?

A Not only nickel aluminide. This was only one of a very, very great number of materials that was included in their program.

Q All right. This was a material included in their program?

A Right.

* * *

Q All right. And one of the combinations which they suggested was nickel aluminum?

A Well again, we come to the point of whether they suggested it or we suggested it. This is very, very confusing.

As I say, we had worked with that kind of coating prior.

Q All right. There I will rely on your deposition and I will not get into it with you.

At this point there is confusion in your mind as to whether you suggested it or whether they suggested

it, but there it was anyway as a material to be tried at this time?

A Right.

Q Now, was this prior to 1956?

A This would be in the 1951 to 1954 time period that I did the work for Climax.

Q Right, sir. But it is prior to '56, in any event, and it is prior to the time that Metco came out with its thermo spray gun, and prior to the time that Metco came out with a nickel powder; is that correct?

A It's prior to the time we put it on the market.

Q Yes.

Now, these properties and I will just mention that on, this high oxidation temperature resistance, is a property associated with nickel aluminide; is it not?

A Yes.

Q And it was know, this nickel aluminide was known to have that property; is that correct, sir?

A There was literature.

Q Right. And it was because of this known property that it was desired by Climax?

A This would make it desireable by Climax.

Q And the property of nicle -- I beg your

pardon -- and the proportions of nickel and aluminum that would produce this desired nickel aluminide was 80 per cent nickel and 20 per cent aluminum; isn't that true?

A Not necessary. There are a number of nickel aluminides and nickel and aluminum combine in -- in all proportions.

Q All right, sir.

Turn to page 63 of your deposition. 63, beginning at line 3, did I not ask you the following question, and did you not make the following replies?

"Question: What was the proportion or did you at the time in '54, '55, when you drew your conclusions, did you determine that there was a proportional relationship?

"Answer: Through the literature studied, particularly one article on work that had been done on nickel aluminides, a particular composition was chosen which in massive form was superior to the other compositions.

"Question: Do you recall what that proportion was?

"Answer: Yes. It was approximately 80 nickel, 20 aluminum by weight.

"Question: You say you read this in the

literature?

"Answer: Yes.

"Question: This to me means there was some publication which reported that this ratio of nickel to aluminum would produce the nickel aluminide which had these properties that you were seeking?

"Answer: That's correct."

I may as well go on reading the next question and answer.

"Question: Did you consider these properties essential to the produce which you were developing?

"Answer: Yes, for the purpose intended, which was the high temperature oxidation resistance, these properties were essential."

Did you make those answers to those questions?

A Yes, I did.

Q All right.

Now, in your work for Climax, you sprayed nickel and aluminum powders, did you not?

A Yes.

Q And what results did you obtain?

A All we did was apply the coatings to panels for

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Climax Molybdenum Company, which they returned to their laboratories for heat treatment and for test.

Q Now, will you describe the composition of the coatings which you sprayed? Did you spray an aluminum coating, and then a second nickel coating? Is that the way you sprayed it?

A Well, I don't recall all of the coating configurations that we sprayed. Some of the coatings we sprayed aluminum first. I'm sure. Then nickel over and then possibly even aluminum over those.

Some of the coatings we sprayed I'm quite sure were nickel first, aluminum and so on.

Q But you sprayed them in sandwiched form, in other words?

A That's right. We did. Also in mixtures.

Q Did you -- you sprayed a nickel aluminum mixture?

A Mixtures of powders.

Q Powders?

A Yes.

Q What did you obtain?

A Also --

Q Let me stay with that one for a moment, Mr. Dittrich, because I'm really interested in the nickel

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and aluminum, not the other powders which you may have sprayed.

You sprayed the mixture. What did you obtain, sir?

A Coatings which were simply mixtures of nickel and aluminum when we deposited them.

Q When you sprayed the mixture of nickel and aluminum, was it a pre-reacted mixture?

In other words, was it nickel aluminide?

A No, sir. They were simply mixtures of nickel and aluminide powders.

(Continued on next page.)

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DIRECT EXAMINATION

BY MR. CALIMAFDE: (Cont.)

Q Did you observe any exothermic reaction of any kind when you sprayed the mixture?

A No, sir.

Q Now, it was known at that time, was it not, sir, that nickel and aluminum would react exothermically if the nickel and aluminum occurred in the proper proportions? That was known knowledge at that time?

A At that time, you mean, this 1951 -- 1954 time period?

Q Yes. When you were working with the Climax?

A Yes I believe it was.

Q Now, as a result of your work with Climax, did you make any -- draw any conclusions with regard to the nickel and aluminum spray powders?

A Did I draw any conclusions at all?

Q Well, did you -- as a result of your work with Climax, did you draw the conclusion that a composite of nickel and aluminum in proper proportions could produce a nickel-aluminum coating?

A No, not at that time, I did not.

Q Now, when did you make that conclusion -- draw that conclusion or make that observation?

A Yes. That was later, after the unsuccessful work with

Climax molybdenum, I continued on and off with spraying layered coatings of nickel and aluminum, aluminum and several other materials, attempting to alloy or react those materials on the surface of the panels, to provide the bonding and the coating that I thought I could get from the materials combination.

Q All right.

Is this work you did back at Metco after the Climax project?

A All of our work was done at Metco. We -- during the Climax project, panels were either sent in to us to be coated by us at Metco,along with some other materials that they were desirous of coating them with

Q How long after your Climax project did you draw this or make the conclusion that a composite of nickel and aluminum would produce the desired nickel-aluminum coating?

A Well, I believe that the disclosure you are leading up to was dated in October of 1955. Sometime in 1955, at any rate. A part of the work that I did, since I wasn't totally successful in reacting the coatings on the substrate, a part of the work that I did involved spraying the coatings onto the substrate, in layer form, removing them from the substrate as a layer, and then by torch heating, alloying

or reacting the sandwich constructions of these various materials. And since the Climax program was unsuccessful, since I was unsuccessful in achieving the kind of coating and bond that I wanted by ~~hearing~~ HEATING the coatings in place on the substrate, then finding that on removing the layers and torch reacting them I could get the exothermic reaction, I concluded at that time that it might be possible to get the kind of coating that we wanted and the better bond by starting with some sort of free standing, that is, a composite that we could spray that would combine and give us the kind of coating that I thought we might get.

Q All right, sir.

Let's see if we can't put this in the right time se uence. You worked with the or on the Climax project. You sprayed nickel and aluminum powder. Your results there were not satisfactory.

A Right.

Q In October of 19 -- October 6, 1955, you prepared a memorandum, it appears; is that correct?

THE COURT: Is that a PX?

MR. CALIMAFDE: It's PX-16, your Honor.

THE WITNESS: Yes.

Q That's the one to which you refer?

A Yes.

Q Yes. Now, prior to the preparation of this memorandum on October 6, 1955, you indicated that you sprayed layers of coatings, nickel and aluminum, at Metco?

A That is right.

Q And that you torched a corner and by torching you applied a flame to a corner of a sandwich?

A Right.

Q And you observed an exothermic reaction?

A Yes.

Q And as a result of what you observed, you then concluded that if you had a composite powder of nickel and aluminum in the right proportions, it could -- it could be used as a flame sprayed powder; is that correct?

A Right.

This is when they were stripped from the substrate.

Q Right, sir. Now, --

THE COURT: When you speak of a sandwich, that reminds me of lunch, among other things. But that's not the purpose of the question.

Is the sprayed material the ham --

THE WITNESS: No, sir.

THE COURT: -- in the middle?

THE WITNESS: No. When we speak of -- just generally, the sandwich coatings, it's --

it's a layered coating system.

THE COURT: One belt on top of another?

THE WITNESS: Yes. For instance --

THE COURT: But we ought -- I think of it as really three pieces. Is that not so? That is to say, do you have a substrate and a coating or when you use sandwich, does it mean substrate and a coating and a coating?

THE WITNESS: Well, we would have a substrate initially, spray onto it a coating of one material.

THE COURT: Right.

THE WITNESS: Then spray onto the top of that a coating of another material.

THE COURT: Right.

THE WITNESS: Potentially on top of that.

THE COURT: Could be more?

THE WITNESS: Yes.

THE COURT: 1, 2, 3 would be what you call a sandwich.

THE WITNESS: Yes. Layered.

THE COURT: A layered deposit?

THE WITNESS: Right.

THE COURT: Of different metals, sprayed on?

THE WITNESS: Yes, sir.

THE COURT: All right.

Now, what does that have to do with what we are discussing here?

THE WITNESS: Initially I was attempting to form nickel-aluminum coatings on the substrate.

THE COURT: In this -- are you speaking now of a molybdenum substrate?

THE WITNESS: That or any substrate.

THE COURT: Or any?

THE WITNESS: Yes.

THE COURT: Was your work done in the context of molybdenum?

THE WITNESS: No, sir. The original work prior to the -- just prior to the Climax molybdenum work, when we were working with these sandwich structures and we had done some work in prior years also with sandwich structures, the object was to try to obtain a coating -- and eventual coating that had the desirable properties of all of the materials that were put into the layers.

See, now, for instance, starting out with a ~~seal~~ steel substrate as I was working with

and then applying a layer of nickel or a layer of aluminum and then nickel and then aluminum, or nickel, aluminum, nickel --

THE COURT: But each one sprayed on as an individual --

THE WITNESS: As an individual layer.

THE COURT: -- layer?

THE WITNESS: Yes.

THE COURT: Yes.

THE WITNESS: As an individual layer, either from powder equipment or wire equipment. We then would heat treat this sandwich structure in order to try to alloy or react the materials that were sprayed on in layers and have these bond very, very securely to the base.

THE COURT: Yes.

Let me ask you this question in that connection. Earlier you referred to a fusing, which was done with the so-called -- I forget what you call it.

THE WITNESS: Self-fluxing, hard-facing alloys, yes, sir.

THE COURT: Right.

Was this torching -- would this torching

be called fusing?

THE WITNESS: Essentially the same. Well, basically the same operation. That is --

THE COURT: For instance, having built up your layered sandwich, let's say that would be cool in the sense of being at room temperature?

THE WITNESS: After being built up, it would be.

THE COURT: Then you would take a torch, oxy-acetylene type torch?

THE WITNESS: Generally, yes, sir.

THE COURT: And just apply that heat over and then see what happened?

THE WITNESS: Yes, sir.

THE COURT: With the idea that there would be a wedding.

THE WITNESS: Hopefully.

THE COURT: And in a chemical or metallurgical sense, there would be --

THE WITNESS: An alloying.

THE COURT: -- a union?

THE WITNESS: Of the individual elements that were applied as layers.

THE COURT: Well --

THE WITNESS: The nickel and aluminum, for instance.

* * *

(Luncheon recess.)

AFTERNOON SESSION

Q As you know, this memo is dated October 6, 1955?

A Yes, I saw it.

Q And you associate with this memo, and the time of the memo, your conclusion with regard to the use of a composite of nickel and aluminum as a suitable powder for flame spraying; is that correct?

A That is correct.

Q Now, can you tell us how many times you sprayed

sandwich configurations before you arrived at that conclusion in October of 1955?

A Oh, I don't recall how many times I did. It was on numerous occasions.

Q Well, now, why would you apply coatings in sandwich form on numerous occasions? What were you trying to seek in applying the coatings in sandwich form? What were you trying to seek the second time that you didn't learn after the first time you applied the coatings?

A We could occasionally see some semblance of bond to the substrate that was achieved.

It was quite sporadic, very spotty. Sometimes we would see it. Sometimes we wouldn't.

There was always the hope that perhaps in changing conditions ever so slightly, that we might be able to achieve what we were trying to do.

Q Now, what were you trying to achieve, sir? Were you trying to achieve a bond?

A There were two things that really we were trying to achieve, one was the extremely good bond to the substrate that we were looking for.

And, number two, were the properties of the material that would result after the fusion or alloying of the material that we put in the layered structure.

Q Well, were you looking for nickel aluminide coating which would bond to the substrate?

A In effect, in that particular construction, this is one of the things we were looking for.

Q And now, it is true, of course, is it not, sir, that in order to obtain a nickel aluminide coating, you necessarily must begin with nickel and aluminum?

A That is right.

Q And then when you sprayed, you have a layer of one of those metals directly on the substrate, and then a layer of the other metal directly over the first? You then obtain something like what I have drawn on the blackboard; is that right?

A The sprayed configuration.

Q Would you use the word clading, to describe the relationship between the aluminum and the substrate, the aluminum clading and the substrate?

A By loosely using the term I would say that.

Q It is in direct physical contact?

A Yes, it is.

Q Then you clad aluminum with nickel?

A Yes.

Q And that was in direct physical contact?

A Yes.

Dittrich - direct

Q Now, that is what you did at METCO?

A Right.

Q You expected to obtain nickel aluminide, and that is what we have been calling - - I won't try to use the formula -- aluminide, I think I am spelling it right -- (indicating on blackboard.)

Now, since nickel aluminide is formed from nickel and aluminum, and you deposit nickel and aluminum on a substrate, and then you apply heat to it, why would you not necessarily get nickel aluminide if you caused these two metals to react and they are in the proper proportions, would you not get nickel aluminide as a matter of course?

A Ithink that you would. Nickel aluminide is a term that we use very, very loosely to cover the entire range of compositions that we might get from combinations of nickel and aluminum.

* * *

Q Let me ask you a question, Mr. Dietrich, when you were spraying the coatings of nickel and aluminum on the substrate you were seeking or you expected to obtain nickel aluminide.

And then you said there were many nickel aluminides, which led me to my next question, that isn't it a fact that you were hoping or you were seeking the nickel aluminide which had the desirable properties of high oxidation resistance?

A We were seeking a nickel aluminum alloy, call it a nickel aluminide, if you will, that would have the desired properties.

Q Right. Now, when you applied a flame, which you have been characterizing as a torch, to a corner of this sandwiched configuration, what did you expect you would have?

A I don't know what I expected. I was hoping that we would get a reaction between the nickel and aluminum which would form the alloy which would bond very, very securely to the substrate.

Q That in fact happened, did it not?

A No, it did not.

Q I thought you testified that you applied a torch to the corner of the sandwich and you then observed an exothermic reaction.

A Well, the exothermic reactions that I got by applying a torch to the core was after that sandwich layer was removed from the substrate. So that in effect we had only the nickel and aluminum in combination.

Q All right, sir, let's understand that. Let me pause a moment to be sure we understand what you have just said.

You removed the nickel and aluminum claded metal from the substrate.

Did you remove it completely from the substrate?

A Yes.

Q Now you just had these two metals, one claded with the other?

A That is right. We had a layer of aluminum, a layer of nickel, or more, which were removed.

Q Were they bonded to each other?

A The nickel and aluminum were adhering to each other, yes.

Q You used the word "adhering."

Do you intend to distinguish that word from bonding? You said they were adhering to each other. My question which I asked was whether they were bonded to each other.

A I think they both mean the same thing.

Q All right. So now you have in effect removed

these two metal layers from the substrate. They are bonded or adhered together.

And I interrupted you at that point in your story. Now, you took that construction and you applied a torch to a corner?

A Yes.

Q What did you expect to have happened when you applied the flame to the corner of these two cladded metals?

A Well, I had hoped that we would get the combination reaction between nickel and aluminum.

Q And that is what you did get?

A That is right.

Q Now, Mr. Dietrich, since you have nickel and you have aluminum in close physical contact, in fact, in adhered contact between these two layers, doesn't it follow as a matter of course that if you apply a flame of a temperature which exceeds the melting temperature of the aluminum they are going to react with each other and you will obtain an exothermic reaction?

A Well, I had hoped and expected that this is what was going to happen.

Q Yes, sir. Now, you knew from the literature that nickel and aluminum were exothermic materials?

A Yes, sir.

Q That when they reacted together they form an inter-metallic compound? Isn't that correct?

A Or a compound.

Q Well, your literature studies revealed to you that if you proportioned the nickel and aluminum, 80 to 20 percent, they would produce a nickel aluminide?

A Yes.

Q And that was an inter-metallic compound?

A Yes.

Q That was common knowledge?

A Yes.

Q You knew, sir, that the nickel aluminide when they reacted to each other, reacted with each other, exothermically to produce an inter-metallic compound, that exothermic reaction of course generated heat? That of course, too, is common knowledge.

A (Witness nods head.)

Q You knew the melting temperature of aluminum --

THE COURT: Did he answer the last question?

MR. CALIMAFDE: He nodded his head.

THE COURT: Oh, I was looking in your direction.

Q You knew that at that time?

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A Yes.

Q So that you knew that if the torch temperature exceeded the melting temperature of aluminum you would cause an exothermic reaction?

A I expected that.

Q And that is what occurred?

A Yes.

Q It was also known to you, was it not, Mr. Dietrich, that by generating heat, exothermically, for example, you would produce a particle that would aid in bonding that particle to the substrate?

A I didn't know for certain, no.

Q Well, when you say, "For certain," wasn't it common knowledge that bonding was aided by heat?

A Up to a certain point.

It was also common knowledge in the flame spray industry that if we should overheat particles this could also be detrimental to the bond and the coating.

Q Now, what do you consider an overheated particle?

A Well, this would depend on the particular material itself.

Q Well, can we say it was a general truism that bonding is aided by heat?

A That, as I previously qualified it --

MR. SPRUNG: Flame spray?

MR. CALIMAFDE: Yes. I am talking about flame spraying.

MR. SPRUNG: Bonding is aided by the flame spray material? Substrate? Or what?

MR. CALIMAFDE: Well, bonding, as we have been using the expression means the bond between the sprayed coating and the substrate.

THE WITNESS: Yes.

Q Do you understand me?

A Yes.

Q Was it not common knowledge that bonding would be aided by the application of heat or by the generation of heat?

A Again I say I have to give that answer a qualified yes because overheating in some cases is detrimental to the bond.

Q Well, I would like to know what you mean by overheating. If you have a particle of nickel, for example, and you wish to use that as a sprayed coating, in order for nickel to be used in spraying -- flame spraying -- you would expect of course the torch to cause the nickel to become molten, would you not?

A Molten or plastic.

tols.

Q Now, you would not intend to heat it so that it still remained in its rigid or solid form?

A No.

Q You would heat it to the molten or plastic form?

A Right.

Q You would heat it to the molten or plastic form because in that form it more readily bonds with the substrate?

A Yes.

* * *

Q All right. Let's discuss that. But let's discuss it in the context of what you did in October, 1955, when you applied the torch to the corner of nickel and aluminum-cladded metal and it exothermically reacted?

A Yes.

Q And that is what you expected?

A Yes.

Q Now, when it exothermically reacted, did those two layers form an alloy?

A The analysis worked by Mr. Tour showed that it did.

Q It showed that it did?

A Yes.

Q Now, at the time that you saw that exothermic reaction, was it apparent to you that the nature of that reaction with the heat of the flame which you used in starting that reaction could produce a particle that would become molten and useful in flame-spraying or as a flame spray particle?

A It appeared at the time that that was a possibility.

Q As a matter of fact, that is what gave rise to Exhibit 16? Isn't that true?

A Exhibit 16? I don't know.

Q I am sorry. That is this memo (indicating).

A Yes.

* * *

Q I am now directing myself to you, sir, and your conclusion at this time."At this time" being in October, '55, when you put the torch to this.

Your conclusion was, I -- if I can produce a composite of nickel and aluminum in close physical contact, of the right size of the flame spraying, I then have a useful flame-sprayed powder?

A This was a part of the mental process that was going on.

Q I understand.

A All of this was in the very, very formative stage.

Q I understand, sir.

So the only question in your mind was, can I produce a particle of the right size in composite form?

A The questions in my mind were -- was, how to produce a particle, how to get something in the configuration that I could use, to try this, to see if I could achieve a result.

Q Well, there were nickel powders available at that time; were there not?

A Yes.

Q And there were aluminum powders available at that time; were there not?

A Yes.

Q And didn't you at METCO have the equipment for agglomerating or for compacting a nickel powder to an aluminum powder, to produce a composite?

A No, sir. I think I testified at the hearings, that we at that time, at METCO, had home-made equipment, we were using for ball milling, but I think I also testified that at that time we did not have equipment that we could use for agglomerating.

Q Now, did you make any effort to make a composite, wire or powder, following the conclusions you arrived at in 19 -- October, 1955?

A No, sir, I did not.

This was only a part of the general work that was going on then. It was not a directly assigned project. There was very, very much other work going on, which required precedence over this and which we were doing by project directive.

Q Will you turn to page 160 of your deposition, please? 160.

Do you see it, sir?

A Yes.

Q Line 16, did I not put the following question to youand did you not make the following answer?

"Question: Now my question has to do with the agglomerating equipment or the equipment at METCO in 1955 which was capable of agglomerating particles. My question to you is whether that equipment could have produced an agglomerate of nickel and aluminum as shown in figure 2 of your patent 248?

"Answer: I suppose it could have."

Did you make that answer, sir?

A Yes.

May I just read over this a little bit?

All right.

Q Now, I understand that no effort was made to produce a composite of nickel and aluminum, or to produce a particle in which the nickel and aluminum were in physical contact immediately following the period of 1955?

A That's right. We had done some previous work, as I testified here, in attempting to ball-mill aluminum with -some other materials together. That was not particularly successful.

Q But, Mr. Dietrich, if you can, my question is specifically now to nickel and aluminum, and I think if we can focus our dialogue better in regard to the issues, we'll all benefit.

The question has to do specifically with what

you did, what effort you made following your observation in October of 1955 to make a composite?

Do I understand it correctly that you made no effort to make a composite?

A We made no physical effort to make a composite.

Q All right.

A At that time.

Q Now, isn't it also a fact that you made no effort to produce a composite for several years thereafter?

A That is true. We made no physical effort.

We were reviewing the literature, though, that was coming out, on methods of cladding one material onto another and looking for commercial means.

Q All right. Why were you looking for something in the literature that would disclose to you how to clad one metal onto another?

Was it first because, in order to have the exothermic reaction, these two metals had to be in close physical contact?

A I would say yes.

Q And you were now examining the literature to see whether there were some techniques developed by some manufacturer before producing these two cladded metals?

A Yes. Some method, some improvement in the state of

the art, that would permit us to have the material manufactured or to manufacture it.

Q All right. So that following your observation then in October of 1955, you thereafter looked at literature to see whether some manufacturer had developed a cladding process that would be suitable for your purpose?

A Well, whether it would be suitable and announced per se as a means of cladding powder particles, or whether it would be a method of cladding onto flat surfaces and might be altered --

Q But, in any event --

A -- a test to form what we wanted. This was --

Q This was the extent of your activity?

A Right.

Q Your reading literature?

A Yes.

MR. SPRUNG: You are talking about Mr. Dietrich personally,now?

MR. CALIMAFDE: He can only speak on behalf of himself, I assume.

THE WITNESS: That's right.

As I say, there was the press of other work.

BY MR. CALIMAFDE:

Q Fine.

A That --

Q Let's talk about -- let's talk about the other work.

A That limited --

Q Isn't it a fact that after this observation, in '55, you then began to do work on a gun?

A It was soon after that.

Q And that most of your energies were directed towards the development of a gun?

A Right.

Q And that there is no pressing -- strike that question.

That was not until two or three years later, in 1959 -- I guess that's almost four years later -- when you read of an announcement by a Canadian company called Sherritt Gordon; is that correct?

A That's correct.

MR. CALIMAFDE: Your Honor, the Maskiw patent is assigned to the Sherritt Gordon Company in Canada.

BY MR. CALIMAFDE:

Q And in this announcement by Sherritt Gordon, in 1959, there was mention of cladding a core metal, if you wish, with an outside metal which might be nickel, cobalt, copper?

A Well, initially their announcement was a very, very simple and short announcement that said that they had the capability of cladding nickel, cobalt or copper.

THE COURT: Is that a Px?

MR. CALIMAFDE: Yes, sir; Px 52.

BY MR. CALIMAFDE:

Q Is this the announcement, Mr. Dietrich, which you saw in 1959?

A Yes, this looks like a copy of it.

MR. CALIMAFDE: Let us mark this Px 52.

THE CLERK: One sheet marked for identification as Plaintiff's Exhibit 52.

(So marked.)

BY MR. CALIMAFDE:

Q So that this announcement was of a capability of making a composite powder; is that correct?

A That's correct.

Q A composite powder in which the outer metal might be nickel?

A Right.

Q And when you read that, it was apparent to you that this composite could be useful in your flame-spraying process?

A I thought on reading that announcement that it might

be a way of making a composite particle that would be useful to us.

Q Right, sir. And then, of course, you corresponded with Sherritt Gordon?

A As I remember my initial inquiry to them, it was regarding their capability of cladding nickel onto core particles and we were, as we always are, deliberately evasive in our ultimate.

My original inquiry was more to find the capabilities of the process, so that I believe in my original inquiry I asked them if they could clad nickel onto oxide particles.

Q In their original announcement, Px 52, Mr. Dietrich, that's this brief announcement?

A That's that?

Q Yes, sir. Sherritt Gordon states, and I quote, "Particles ranging all the way from less than one micron to several hundred microns can be coated this way and lend themselves to roll compacting." And so forth.

Now, this range of one micron to several hundred microns, that encompasses the flame spraying range of particles sizes?

A Generally, I would say so.

Q And in fact, in the same announcement, Sherritt Gordon gave as an example nickel, three percent

chrome oxide material? Do you recall that?

A I don't recall it. It's probably in there, yes.

Q So that their announcement included the information of cladded particles of a size between one and (700) microns, and they gave as an example, as a successful example, nickel, chrome oxide?

A Yes.

Q Based on this announcement, it occurred to you that this ould be a suitable material, composite material for use in flame spraying?

A It occurred to me that that might be a useful way of forming particles for our process.

Q And then you wrote to Sherritt Gordon?

A Yes. I believe it was a letter inquiry the first --

Q And you obtained from them samples of cladded particles?

A They -- well, first of all my inquiry to them was whether they could clad nickel onto aluminum oxide and cobalt and to zirconium oxide, I believe, or the original ones.

(continued on following page)

Q Mr. Dittrich, let me see if we can't contract this.

A In a size range.

Q Yes. But I'm trying to contract it and I'm really not asking for how you may have eluded Sherritt Gordon from understanding your purpose for this powder.

I would rather confine ourselves, if we can, again, to what is relevant to this proceeding.

A Well, yes.

Q You inquired of Sherritt Gordon as to whether they could clad or make for you a nickel clad particle? Among other things, you asked for that?

A Right.

MR. SPRUNG: That's a -- that isn't what -- he's telling you what he asked them.

Q Is the answer to my question yes, that among other things you asked for a nickel cladded particle?

A Yes, that's correct.

Q And eventually they produced such powder for you?

A Well, when they answered that they could clad these specific oxide materials, that announcement was a very, very simple announcement that covered, I believe, only that one material that they mentioned.

That didn't mean that they could clad nickel or cobalt

to copper onto every kind of material.

Q No, sir. I understand that.

A So my original inquiry to them was whether they could clad it onto the aluminum oxide and onto cobalt.

When they returned with their "Yes" answer, then I ordered the materials from them.

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Q I'll show you Plaintiff's Exhibit 50, which is a letter from you to Mr. Pearce of Sherritt Gordon dated July 1, 1960.

THE COURT: That is 50, you are showing him?

MR. CALIMAFDE: Yes, sir, 50.

MR. SPRUNG: 1960.

MR. CALIMAFDE: Is that what I said?

THE COURT: Then that is not in this book, if it is 50.

MR. CALIMAFDE: It's 50.

THE COURT: I beg your pardon. I apologize. I see. Okay.

Q Now, do you recall sending this letter to Mr.Pearce?

A That is over my signature, so I did send it, that's correct.

Q And in the middle there is a paragraph which

reads, "We would like to have this powder coated with nickel to give a finished powder which is the following composition by weight," and then you show aluminum, 17.5 per cent. Then you have a dash 1 1/2 per cent.

A Yes, sir, but this is not the first order for powder that I sent up to Sherritt Gordon.

Q Is that the first order for powder consisting of nickel and aluminum?

A It is not the first order for powder consisting of nickel and aluminum.

Q All right. This, your Honor, is apparently a first -- the first correspondence we have, which was produced for us, which indicates an order for nickel and aluminum.

But it's your recollection, in any event, Mr. Dittrich, that there was a prior request from you for a nickel aluminum composite from Sherritt Gordon?

A That is correct.

MR. SPRUNG: The deposition says they sent a purchase order up requesting that.

Q The answer is "Yes"?

A Yes.

MR. CALDWELL: Would you mark 50, please?

THE CLERK: For identification?

One letter dated July 1st --

THE COURT: Let me make certain. You say it is established that this is the first order?

MR. CALIMAFDE: He recalls an earlier order.

THE COURT: Oh, then this is an order?

MR. CALIMAFDE: That's an order.

MR. SPRUNG: In his deposition they said they sent a purchase order for the material, which was destroyed.

THE COURT: Earlier?

MR. SPRUNG: Yes. Just about the time of the original correspondence.

THE CLERK: One letter dated July 1, 1960 marked for identification as Plaintiff's Exhibit 50.

(so marked)

BY MR. CALIMAFDE:

Q I will show you now a memo which is marked PX33, which is handwritten and addressed to Bud. Is that your handwriting?

A May I see it?

Q Yes.

A Yes, sir. This appears to be my handwriting.

Q All right. Attached to that handwritten memo

is a two-page typewritten document which is signed, I believe, by you. Is that your --

A It is.

Q This document is dated December 18, 1959?

A Yes.

Q And on the first page of the typewritten document --

MR. CALIMAFDE: Your Honor, this is the first page, the first typewritten page attached to PX33.

THE COURT: Yes.

Q And if you come down one, two, three, the fourth paragraph from the top, "When composite powder became available, I asked Sherritt Gordon to prepare a special powder," and so forth?

A That's right.

Q That refers to a nickel clad aluminum particle?

A It does.

Q And that's about an 80-20?

A It's nominally 80-20.

Q Now, in the second sentence of that same paragraph, you said, "I thought that the heat of formation of the nickel aluminum (an exothermic combination reaction) would add in giving a self-bonding oxidation resistant coating

of nickel aluminum"?

A Yes, sir.

Q All right.

Now, at this time, 21 December, 1959, 18 December, '59, the date of your typewritten memorandum, had you yet received nickel aluminum particles from Sherritt Gordon?

A Let's see. I -- I believe that -- as I recollect, we had, and that --

MR. SPRUNG: Refer the witness' attention to paragraph 1. Is that helpful to him?

MR. CALIMAFDE: Which part? The whole thing?

MR. SPRUNG: No. Just one. You asked him a question. I'm trying --

THE WITNESS: Well, by my statement in paragraph 1, down below here, even this first composition powder is self-bonding on the fine ground --

(continued next page)

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THE COURT: What paragraph is that?

THE WITNESS: Down at the bottom of the page.

MR. CALIMAFDE: There you are.

THE COURT: Oh, numbered one. I thought he was referring to the first paragraph.

THE WITNESS: This would indicate that by this date I had received that initial sample and that I had done some work.

BY MR. CALIMAFDE:

Q And that the first composition powder was self-bonding?

A That's right. That would be the nominal 80-20.

Q So that what you had observed in October, 1955 in regard to the exothermic reaction between nickel and aluminum and your conclusion that if you could place -- if you could make a composite particle of nickel and aluminum, it would be suitable for flame spraying, was borne out as evidenced by this paragraph numbered one?

A I would say, yes.

That doesn't, of course, go into all of the test work that went with it, you know, in separating into particle size and everything else.

These were some general conclusions that were drawn as a result of the work with those.

Q When you say the general work regarding separation into particle size, are you now referring to the sizing of the particles you received from Sherritt Gordon?

A Yes.

Q And you sized it so it could be used with the Metco gun?

A Well, what we received was a broad particle size range.

Q Right.

And within this range, you selected the --

A We picked out particles sizes by test.

Q And then you put that into your Metco gun and you sprayed and the composition was self-bonding?

A Yes.

* * *

Q Now, what did you do following the observation you made on Exhibit 33, that column numbered one?

I beg your pardon. Paragraph numbered one.

A That parenthesis part?

Q Right.

A Prior to that, also subsequent to that, there were discussions with Bud Shepard, who was my boss at the time and who is named as a co-~~defendant~~ inventor here, particularly after regarding usefulness of the material. It was probably about that time that we would have reported to our management.

Q Your management?

A Our management, that we had a potential product, in this self-bonding material, which was very, very highly desirable for the process because there was no other self-bonding material for powder spray.

Q All right. Now, at and around this time of your -- your letter -- your memo dated 21 December, '59, when you commented on the nickel-aluminum particle, did you also obtain other composite particles for testing?

Perhaps I could help you. Did you obtain a

nickel-phosphorous composite from anyone now? Not just Sherritt Gordon.

A At some point in time, the exact dates of which I am not sure, we did obtain some composites that were nickel-phosphorous,yes.

MR. SPRUNG: When you say "nickel-phosphorous," do you mean the alloy nickel-phosphorous or elemental phosphorous composited with nickel?

MR. CALIMAFDE: I am talking about the unalloyed nickel phosphorous. Nickel and phospho composite powder.

A (Contin ng) I believe we got from Sherritt Gordon some nickel on elemental phosphorous.

Q And did you test that as you tested the nickel aluminum?

A Yes.

Q Composite?

A Yes.

Q And did the powder, the nickel phosphorous powder, which you obtained, did it have about eight to twelve percent phosphorous?

A I don't recall the percentages any more.

Q It was tested?

5

A It was tested.

Q And was it determined during spraying that the phosphorous combined with the nickel in an exothermic reaction?

A We assumed that it did, more than anything else.

Q And it aided in the bonding?

A It aided in the bonding but it was not self-bonding.

Q But it aided in the bonding?

A On already roughened grit blasted surfaces, I would say that there probably was bond improvement.

* * *

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Q I believe you were talking about a nickel phosphorus powder before the recess?

A Right.

Q I ask you whether you obtained and tested a nickel phosphorus composite and you indicated you had.

A Yes.

Q I ask you whether the nickel and phosphorus combined in an exothermic reaction and you indicated it had.

A We assumed that it had.

Q Would you look at page 180 in your deposition.

A 1807

Q Yes, 180.

A All right.

Q Line 9.

Could I ask you the following question, and I quote:

"Question: Now, about the fifth line from that paragraph of example 11 that they are referring to, in your patent, the statement is made that during the spraying, phosphorus combines with the nickel in an exothermal reaction.

"Answer: Right.

"Question: How is that determined?

"Answer: By visual observation."

Now, I asked you before the recess whether that aided in bonding and I believe you qualified your answer by saying

yes, but it required, I believe you said, grit blasting or cleaning.

A What I said was that the nickel phosphorus combination was not self-bonding, that is bonded to the grit blasted surface by the normal mechanical lock, that the principal improvement in bond came because the material was self-fluxing.

Q Will you look at page 182, please, in your deposition, beginning at line 11.

A Beginning with line 11?

Q Yes.

Let us go back a little earlier, to about line 7, page 182, did I not ask you the following question: "Doesn't an exothermic reaction necessarily produce an inter-metallic compound?

"A Yes, but if I directly -- well, if I remember correctly, phosphorus is not a metal.

"Q If it were, it is an inter-metallic compound; and it is not a compound, then it is a compound between phosphorus and nickel?

"A Yes.

"Q Can you tell us whether the fact that the reaction is exothermic aids in the bonding of the powder to the substrate?

"Answer: I expect that it would, the extra heat generated in flight, I expect in bonding."

Did you give those answers to those questions?

A Yes, and that is not inconsistent with what I just said regarding it.

Q I may have misunderstood something that you said.

So that the nickel phosphorus produces an intermetallic compound even though there is a question in your mind as to whether phosphorus is a metal?

A I think we had determined that phosphorus was not a metal.

Q I am not sure we had, but in your opinion it is not in any event?

A Yes.

Q The nickel reacts with the phosphorus to produce a compound?

A Yes.

Q And that reaction is exothermic?

A Yes.

Q And that generates heat?

A Yes.

Q Now, there came a time when you submitted a disclosure for your patent, patent disclosure.

When the application was prepared was it shown to you before it was filed?

A Yes, and I believe we did check with those.

Q And were you kept informed of the progress of that application in the patent office?

A Only on very seldom and remote occasions, but Shepherd, Bud Shepherd, who is my boss and co-inventor, was the contact between our management and the attorneys.

Q Is it fair to say that you were periodically kept informed of the progress of that application?

A Sometimes I would be told what was happening.

Q Did you prepare a table of exothermically reactable metals for use in the application?

A Yes.

Q Now, the table lists pairs of metals; is that correct?

A Yes.

Q And the pairs are those which exothermically react with each other to form an inter-metallic compound?

MR. SPRUNG: Are you referring to the table in the patent?

MR. CALIMAFDE: Yes. I am talking about the table in the patent. I think they are both the same. Are they not?

MR. SPRUNG: Yes.

Q Do you understand what I am referring to, the table in the patent?

A Yes.

MR. SPRUNG: Which application are you talking about?

You testified about the first application which didn't have that table.

MR. CALIMAFDE: You are quite right.

Let me get myself organized with regard to that.

Q Let me show you Plaintiff's Exhibit 25 which consists of a listing of what comes under the heading exothermic and possible exothermic.

MR. SPRUNG: Is that one that the witness prepared?

Q Did you prepare that list?

A Yes. The principal entries are mine.

Q That is in your handwriting?

A The columnar entries.

Some of these, some of the handwriting is notations on here and they are not mine but basically the list is.

Q The list of the metal components or whatever they are, the list of the things on the left-hand column were

made by you?

A Yes.

Q Were those intended to be metals or what?

A They were exothermic components.

Q Now, shall we assume, Mr. Dietrich, that the list of components in the left-hand column are exothermics or possible exothermics?

A Yes, that is my intention on the table.

Q Does that answer apply to the three pages which constitutes this exhibit? They seem to be alphabetically in order or almost.

A I don't know who prepared this typewritten copy.

Q Exclude the typewritten sheet.

A The three sheets?

Q These are exothermic components?

A Yes, according to the literature study that I did.

Q That is my question, you obtained these from the literature?

A Yes.

Q So exothermic components were known in the literature prior to the time you began to work, prior to 1955?

A Yes, compound formation in the system was known and that they were exothermic was also perfectly known.

Q When these exothermic materials reacted together, they generated heat. That was known?

A Yes.

Q Now, the next question to you is that the amount of heat was also in the literature, was it not?

A Yes, sir. There were texts available that gave some reaction.

Q Not only the exothermic material but the heat or amount of heat that these materials would generate when they interreacted was also in the literature?

A Yes, but as I recall the literature at this time, the amount of data available regarding heat, the reaction was not as far as -- not as prolific as it is today.

Q But, in any event, what appears here is what you got from the literature?

A Right.

* * *

Q Let us take nickel and aluminum, when they come together, when they interreact to form an intermetallic compound, it is that interreaction that generates the heat of 3,000 to 7500 calories; is that correct?

A No.

Q It is not a heat of some solution, for example, that we are talking about. We are talking of an exothermic inter-metallic reaction as generating the 3,000 calories.

A Yes, sir. But my understanding is that when an atom of aluminum combines with nickel it releases a certain amount of heat during the combination, during the reaction.

Q This is the inter-metallic reaction?

A Well, the simple combination of nickel and aluminum. Each atom, according to my understanding, releases -- that is, there is a certain amount of heat released as each single atom combines with the aluminum.

Q To form the inter-metallic alloy compound?

A Whatever it forms.

Now, each atomic increment adds its increment of heat so that starting from a single atom of aluminum going up to as many atoms of aluminum, as you put into the nickel, the heat released progressively increases as the aluminum proportionately increases.

Q I do not wish to go into a theoretical explanation.

When you went to the table to extract this heat information, this thermal information, the table to which you went was a table of heat generation for an inter-metallic reaction; is that true?

A I don't know that the table specifically said that. I don't recall what the specific table said.

Q Do you know what those tables were?

A I don't have the book here.

Q Did you hand him something?

MR. SPRUNG: I handed him the book.

MR. CALIMAFDE: Why don't you do that on your examination of the witness and don't take my time up with that.

MR. SPRUNG: You wanted him to identify the book.

MR. CALIMAFDE: I asked him to identify the tables.

MR. SPRUNG: I think this is the table he used. If you want him to identify it, he will. If you don't want him to identify it, he won't.

Q Is the heat -- or can we agree, Mr. Dietrich, that the heat which is being discussed in column 3, the 3,000 calories, the 7500 calories, is not the heat generated by the exothermic oxidation reaction?

11

A No.

Q That we can agree on, that the oxidation, the exothermic oxidation reaction is not the heat which is being disclosed or discussed in the patent as the additional heat that is being generated by these metal parts; is that correct?

A Yes.

Q I would now like to direct your attention to Plaintiff's Exhibit 21, 22 and 24, and while Mr. Gordon is looking for that, let me discuss a moment more with you these imperfect metal heat additions, so we are clear in our mind what is being discussed.

When nickel reacts with aluminum to produce a nickel aluminide, that is an exothermic inter-metallic reaction that produces an increment of heat, if you wish -- shall we call it plus heat?

THE COURT: Are you agreeing with that?

THE WITNESS: So far.

Q Let me call that increment of heat, which is nickel plus aluminum, inter-metallic exothermic reaction. It is also true that you get an increment of heat when aluminum reacts with oxygen?

A Yes.

Q And that is what we have been referring to as the

exothermic oxidation reaction?

A Right.

Q And as a matter of fact, the increment of heat resulting from the exothermic oxidation reaction is far greater than the increment of heat produced by the reaction between nickel and aluminum; isn't that true?

A Yes.

Q What you have said previously is that the increment of heat generated by aluminum and oxygen is not the heat which is being discussed in your patent?

A Right.

* * *

Q All right, sir.

Now, yesterday, we discussed Sherritt-Gordon powder, which was announced in a publication.

Am I correct in understanding that when you read that announcement, you then wrote to Sherritt-Gordon and you ordered a powder of nickel and aluminum?

A Yes, sir.

Q And you specified a range of sizes?

A Yes, sir.

Q Did you specify the aluminum because you knew that Sherritt-Gordon's process would permit the cladding of aluminum with nickel?

A I assumed it would.

* * *

Q Now, Mr. Dittrich, I'm now referring to P.X. 1, which was filed on November 22, 1960. At page 10 of that exhibit there appears in the middle of the page the paragraph which reads, "The following examples are given by way of illustration and not limitation."

Do you understand what that statement means?

A Yes. It's to illustrate the invention.

Q So that these examples which follow are illustrative of what you believe your invention to be?

A Yes.

Q Now, the first example is an aluminum powder, coated with nickel?

A Right.

Q Is that 80/20 proportion powder or about 80/20?

A Roughly, yes, sir.

Q Is that the powder which you obtained from Sherritt-Gordon?

A Yes, sir.

Q I will now direct you to page 16 of PX 1. Under Example 5, "A nickel phosphorus powder having a size between 200 and 325 mesh and containing 8 to 12 percent phosphorus is coated with nickel to form a composite clad," and so forth.

Do you know from -- well, first let me ask you, do you know whether that example was actually a -- an example of a test you conducted with this nickel phosphorus powder?

A We did have a nickel phosphorus powder clad with nickel by Sherritt-Gordon.

Q Do you recall from whom you obtained the nickel phosphorus powder?

A I don't believe that we did. I think that Sherritt-Gordon supplied that core material.

Q Shall we understand then that at the time you saw the Sherritt-Gordon announcement, you ordered the nickel aluminum powder in the 80/20 proportion and you also ordered a nickel phosphorus powder?

A No, sir. This came a little bit later in that time

period.

Q All right.

And now towards the bottom of the example, you have this coating -- well, rather than for me to read it, would you just read that last paragraph? Not out loud. Just read it.

THE COURT: Are you still referring to Example 5?

MR. CALIMAFDE: Example 5. If you will just read it. Then later --

THE COURT: To himself?

MR. CALIMAFDE: Yes, sir. There is no point in cluttering up the record. Later I will refer back to the statement.

A (Continuing) Yes.

Q All right. Now I would like you to refer to the page 21 of the same file history, Example 11. Is this another illustrative example of what you believed your invention to be?

A This powder was also made for us by Sherritt-Gordon.

Q Now, this powder under Example 11 is described as a nucleus of elemental phosphorus powder was coated with nickel to form a nickel-clad flame spray powder, having a certain sizeand containing 80 to 90 -- is that 98? 98 percent

nickel. Based on the phosphorus?

A That looks like 98 percent.

Q And that powder was also obtained from Sherritt-Gordon?

A Sherritt-Gordon.

Q Now, as we read on in that example, the composite was sprayed with a flame spray gun described in Example 1. Shall we assume that the -- that this example was actually tested?

A Yes, sir, it was.

Q Did you test it?

A Yes. I was a party to the test, yes.

Q And is the description here a fair description of what you observed as a result of testing with that powder? In other words, during the spraying, phosphorus combination with the nickel in an exothermic reaction?

A We believed that we saw the --

Q Exothermic flashing or whatever it is?

A Yes, sir.

Q Greatly enhancing the thermal efficiency of the spraying and producing an excellent coating? What do you mean by, "excellent coating"? Did you mean it was self-bonding?

A No, sir, it was not self-bonding.

Q Was it an adherent coating?

A On a grit-blasted surface, that is, a mechanical bond, it was an adherent coating, yes.

The value of that particular materials combination appeared to be only that since it was self-fluxing, after post-heating to fuse it, then it would adhere strongly to the base.

* * *

MR. CALLAFDE: This application, PX-1, was filed. The patent office rendered what they call an official action in which the patent office said that the application contains claims to two separate and distinct inventions and restriction was required.

There is no reply to that and the application was abandoned. So there was no action on the merits of the first application and there was a restriction that separate applications be filed. And this PX-1 was thereafter abandoned.

That takes us to the next application.

The next application, which is PX-2,

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being serial number 134544 was filed August 16, 1961.

Now, this application is not one that resulted in either of the patents in suit. It is not one, sir. Its relevance is related only to the citation of the examiner of the Gutzeit patent. That's this nickel phosphorus patent.

MR. SPRUNG: Your Honor, he -- I think it should be brought out that was the subject matter in the first application carried over through in the second application. The disclosure telling --

MR. CALIMAFDE: That has nothing to do with the statement I'm making.

MR. SPRUNG: Yes, I think it has.

MR. CALIMAFDE: I have said that this application is not a predecessor to one of the two patents in suit. This is directed to a refractoryooxide plus nickel aluminum.

MR. SPRING: That's what was claimed -- in other words, you have a continuity carrying subject matter out. The subject matter was broad. You retain this subject matter which he admits

had nothing to do with it. The continuity of subject matter went into another application and then in another which finally issued in the patent.

What he was doing is taking examples which have no relation to the patents in suit and trying to get the impression or get the witness to testify and use the word "invention" or what-not, to give the impression that these examples were related and I think that we should only have the witness testify to anything that was part of the invention of the patents in suit and anything that was not part of the inventions in suit are irrelevant in this case.

MR. CALIMAFDE: I am not --

THE COURT: Well, I would say I would tend to agree with that.

* * *

MR. CALIMAFDE: Well, they were abandoned, your Honor, because they learned of this Gutzeit patent and then they withdrew the example from the application.

MR. SPRUNG: That's a mischaracterization. And I resent it.

MR. CALLAFDE: That's the point I'm making, your Honor, that --

MR. SPRUNG: If Mr. -- I prosecuted the application. Let's have the best. I'm willing to take the stand, if the attorney wants and I will testify what was prosecuted because I did it.

MR. CALLAFDE: Your Honor, rather than get into arguments --

THE COURT: I suspect you did, Mr. Sprung, from your name throughout.

MR. SPRUNG: That's the best. I know why I did these and why they were done.

The inventor has no idea. This was done for legal reasons.

MR. CALLAFDE: Your Honor, all I'm trying to estaolisn from this inventor that in the first filed application, wnicn is the parent to the application -- to the patent in suit, the patent in suit goes back to November, 1960. Only because of PX-1. So that this is part of the application which resulted in the

patent in suit.

The subject matter in this application which is common to --

MR. SPRUNG: Common to, that's the whole -- so he can only examine as to common subject matter.

(Continued on next page.)

S FOLS.

MR. CALIMAFDE: I am not limiting my examination to that. But, in any event, your Honor, the only point I wanted to make in regard to the first filed application is that it contained examples to nickel phosphorus and they were tested examples. I have nothing more to say about patent applications.

MR. SPRUNG: And I object to them because it has not been established that there the continuing subject matter have any relation to the invention of the patent in suit.

MR. CALIMAFDE: They have a relationship.

THE COURT: I must say I am inclined to agree with you once in this matter of your objection.

MR. SPRUNG: As I have said, I have made an offer. If he is interested in finding out why these things were prosecuted and what was done, I am willing to get under oath and take the stand and let him examine me, because I did it; nobody else knows about it but me.

* * *

Q Mr. Dittrich, would you look at patent 515. Look at Table 1, which appears in column 15. Do you see that, sir?

A Yes, I do.

Q Now, as I count, there are about 142 combinations there, and what I wish to ask you is do you know how many of these you tested for operability or coating efficiency?

A There were only a few of those materials combinations that were tested. This table is the result of a literature study.

Q So as the result of the literature study you arrived at these combinations and presumably these combinations are exothermically reactable materials?

A We expected that they would be from the information, yes.

Q And then you have a number of examples in this patent from 1 to 33, I see. Can you tell us whether the examples are representative of tests you actually conducted?

A Some of them were tests actually conducted. Some are theoretical, but without reading over the whole thing, I don't recall what examples we did cite.

Q Are you do recall that you did not test 32 examples?

A I don't recall to this all 32. As I say, I don't recall which ones I did test.

Q If you look at Example 1, column 6 --

A Yes.

Q -- there's an example of aluminum and nickel.

A Yes, sir.

Q That is the material you obtained from Sherritt-Gordon?

A That's right.

Q On line 32 where you begin with, "The powder thus formed is flame sprayed..." -- do you see that?

A Yes, sir.

Q You indicated that the surface was cleaned with emory cloth.

A Yes, sir.

Q Is that an abrasive cloth, the emory cloth?

A Yes, it would be.

Q That is to make the surface abrasive -- coarse?

A No, sir. It's to make it clean.

Q Only clean?

A Only clean.

Q All right. Now, if you look at Example 2, which

is in column 7 --

A Yes, sir.

Q Column 7, where --

MR. SPRUNG: Which patent are you referring to?

MR. CALIMAFDE: 515, about line 65, 64.

A Yes, sir.

Q You indicate that the -- you removed the surface contamination, copper and copper base alloys, rough ground or light grit blasted. Is a rough ground or a light grit blasted to be distinguished from an emory cloth cleaning?

A Yes, sir.

Q So that a rough grounding and light grit blasting produces a coarse surface?

A No, sir.

Q Pardon me?

A A rough ground surface would still be characterized as a smooth surface.

Q But it is rougher than an emory cloth finish?

A It could be rougher than the smooth emory cloth, slightly rougher.

Q And the light grit blast, is that rougher than the rough ground?

A Oh, I would say slightly less, yes, sir.

Q So that we now have three grades, we have the emory cloth, the rough ground and the light grit blasting?

A Yes, sir.

Q Now, if you look at another example such as Example 7, which is the next column, column 8, line 71. "The material prepared by grit blasting."

A Yes.

Q Is that a fourth category of roughness?

A Yes, sir, it would be much rougher.

Q Do you know why some of these examples indicate that the base material was grit blasted, another example, light grit blasted, another example emory cloth finished?

A Rough grit blasting would be used for mechanical bonding. The other three preparations would be minor variations in surface roughness to test the effect on the bond.

* * *

Q My question to you, Mr. Dittrich, is whether some of these examples result in a coating which is not self-bonding, as we have been using that expression?

A It is possible -- I don't recall all of these -- the results, the specific results from all of these examples.

Q Well, is it your testimony that where the example describes a grit blasting, the grit blasting was for a mechanical bond and not a self-bond?

A The grit blasting would be an aid in bonding, yes, sir.

Q Grit blasting is an aid in bonding, but I don't believe you have answered my question, sir.

Is it a mechanical bond or is it a self-bond? By self-bond we mean an alloying or a welding or -- an alloying is good enough.

A Yes sir.

Q Between the coated material and the substrate?

A Yes.

Q That is what we mean by self-bonding?

A Yes sir.

* * *

the expression "high quality coating." The example is of a -- I will chance it and say disprosium powder. Am I pronouncing it correctly?

A Yes.

MR. SPRUNG: As good as I could do it.

Q Did you test that?

A I don't recollect testing this, but when we formed these examples, why, we expected that they would produce the high quality coating.

Q Is that because these examples were of exothermically reacting materials?

A That and -- well, yes.

Q And since they exothermically reacted they produced heat, and that heat, in your opinion, would aid in bonding or produce a better coating; is that correct?

A If a powder were marginally heated in the flame, my idea was that any heat that we may get due to an exothermic reaction would aid in bonding, and improving the coating.

Q And is that the basis for characterizing the coatings in these various examples which were not tested?

A Yes sir.

***

Q Do you recall whether that produced a self-bonding coating?

A Yes sir, it did.

Q All right. Turn to that table again which is in the next column, 15.

Can we agree, Mr. Dittrich, that the combinations in table 1 are all of materials that will exothermically react to produce an intermetallic compound?

A I did a study, a literature study, prepared tables. I assume that this is a copy from those tables and therefore they would be exothermically reacting materials.

* * *

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please, in the patent in suit, 515.

Do you see it, sir?

A Yes sir.

Q This is not descriptive of the Sherritt Gordon type powder particle; is it?

A No sir, it's not.

Q Now, this particular example describes a powder having 15 percent aluminum and 85 percent nickel by weight. Did you test such a sample, prior to the filing date of this patent?

A Yes, sir, I did.

Q Did you?

A Yes.

Q Do you know whether Metco sells a powder, commercially of course, having those proportions, 85 percent nickel and 15 percent aluminum by weight?

A Not manufactured by this process, no.

Q By what process?

A By this cladding process.

Q No. You say not manufactured by the process of 31?

A Oh, our 404 powder is --

Q That's the Sherritt Gordon process?

A Yes.

Q So that the 85-15 which Metco sells --

A We don't sell an 85-15.

Q Not at all?

A No sir.

Q All right. I misunderstood you.

You don't sell an 85-15 at all?

A No sir.

Q Do you know when this process of example 31 was developed?

A It was in the early 1960s.

Q It was developed after the first filed application, which is November, 1960?

A Yes sir.

Q Now, this last was filed in 1964.

Can you tell us whether it was developed in 1963?

A Well, it would have been developed before 1964.

Q Yes.

A So it was in the time period there between --

Q All right. Close enough.

Why did you change from the Sherritt Gordon

particle to this process for making a particle, this process being example 31?

A The development of this cladding process came as a result of some other work I was doing with some other materials. When I found that I could achieve a result using this cladding process with this other material, I tried putting the aluminum onto the nickel particles in the same manner.

Q Using a binder?

A Using a binder.

Q And then you made an example such as 31, with 15 percent aluminum and 85 percent nickel?

A This was one of the examples, yes sir.

Q And you testified --

A This was one of the powders, not one of the examples. This is one of the powders that I made.

Q And you tested this example 31 in those proportions, 85-15?

A Yes. As I said, this was one of many.

Q Was that -- did the test results produce a satisfactory coating?

A Yes sir, they did. They did, yes.

Q And now, after you had completed your testing of this, as I understand your testimony, Metco does not sell an 85-15 powder?

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A No sir.

Q Did you report your test results to someone in management at Metco?

A Yes sir, but what I -- again I have to say that this was one of many compositions that were tested, all in the same time period.

Q Do I understand correctly that your example 31, powder of 85-15, made that way, was not commercially listed by Metco?

A No, this particular one was not.

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Q Is nickel phosphorus an exothermic combination?

A We expect that it is, yes, sir.

Q Is nickel titanium an exothermic combination?

A Yes, sir.

Q Is aluminum and -- palladium is pd; isn't it?

A Yes, sir.

Q Is that an exothermic combination?

A From the literature study, I expect it is.

Q Is aluminum copper an exothermic combination?

A It might be. I don't recall.

Q Are all of these metals? With what you consider to be an exception phosphorus?

A Yes, sir.

Q The rest are metals. In your opinion, phosphorus may not be or is not.

Now, there is no dispute, then, that the last three, nickel titanium, aluminum palladium, aluminum copper are metals and metal combinations?

A That's right.

* * *

Q Here is Exhibit 21 and here is Exhibit 22 and I understand these are not in your handwriting and you have no knowledge of them.

My question to you, sir, is, where the exhibit shows titanium and nickel, aluminum and palladium as being prior art, do you know of your own knowledge whether those combinations were prior art, prior to your -- the filing date of your first filed application?

A In 1960? No, sir, I don't.

Q Can you tell us why those particular metal combinations do not appear in your table in the patent?

A No, sir.

Q Do you know that they do not appear in the table in your patent, 515?

A I would have to check the patent.

Q Well, why don't you? It will take you a second because they are alphabetically listed.

MR. SPRUNG: Do you represent that they do not appear?

MR. CALIMAFDE: I cannot find them in the tables and, in fact, I cannot find the nickel phosphorus either in the table, and I represent to you it's not there, either.

BY MR. CALIMAFDE:

Q Now, do I understand your testimony, you have no knowledge of why those particular combinations are not in the patent table?

MR. SPRUNG: Would I -- like to refer, if I may, the witness' attention to Example 6 of the --

MR. CALIMAFDE: That's not my question. You are interrupting my testimony. I'd like to

get through with this person.

I asked about the table.

MR. SPRUNG: You are saying it doesn't appear in the patent.

MR. CALIMAFDE: I didn't say that. Now don't -- I did not say that.

I said it does not appear in the table.

Previously, we discussed Example 6, which has nickel titanium, and I discussed nickel titanium with him specifically as to whether he knew it had self-bonding characteristics.

The question now is limited to the table.

MR. SPRUNG: All right. Yes.

MR. CALIMAFDE: As I say, I represent to you that in this table, none of those combinations appear.

BY MR. CALIMAFDE:

Q Now my question to you, Mr. Dittrich, is whether you know or whether you have any reason to believe, as a result of discussions between you and patent counsel or you and Mr. Shepard, that any of these combinations were in the prior art?

A I didn't recollect discussing anything about those with Mr. Shepard or our patent counsel.

Q Do you have any knowledge as to why those combinations which appear on the blackboard are -- were not included in the table of either patent-in-suit?

MR. SPRUNG: You mean, as a group or individually?

MR. CALIMAFDE: No. Those combinations, I said. Anyone.

MR. SPRUNG: Any --

MR. CALIMAFDE: Anyone of --

MR. SPRUNG: Do you know why nickel phosphorus --

MR. CALIMAFDE: Anyone of these combinations. All right. Strike nickel phosphorus.

Anyone of these last three, which indisputably contain nickel -- contain metal components.

Do you have any knowledge as to why any one of these three, nickel titanium, aluminum palladium or aluminum copper was not included in the table in either patent-in-suit?

MR. SPRUNG: Are you indicating no by shaking your head?

THE WITNESS: No, sir, I can't recollect.

* * *

Do you have the 248 Patent?

A Yes.

Q Beginning at line 25: "The spraying in all other respects is effected in the conventional wellknown manner using conventional flame spray equipment and the conventional surface preparation may be utilized if desired."

A Yes, sir.

Q Do you accept that statement as properly characterizing the status of the process as of the filing date of the patent?

A Yes.

MR. SPRUNG: I think the --

Q Thank you.

Can we also agree, MR. Dittrich, that Nickel and aluminum was a known combination which in the proper proportions was known to react exothermically to produce the intermetallic aluminide?

A OUtside of the flame spray industry, the literature indicates that this was known, yes.

Q Can we also agree that it occurred to you that the combination of nickel and aluminum could be useful in flame spraying if it could be made in a proper form and size?

A There was not, I don't think , any one step in the whole sequence of events, that is my reading the article, my work with the layered coatings, and torching the coatings and everything else, I don't think there was any one particular step in that whole chain that told me it would be useful as a flame spray powder.

It was only after I managed to obtain the powder and sprayed it that I was sure it could be useful.

Q I don't believe that was my question, sir. My question to you was whether we could agree that it occurred to you that the combination of nickel and aluminum could be used or useful in flame spraying if it could be made in a proper form and size for flame spraying?

MR. SPRUNG: At some point of time it occurred to the --

Q Is that correct?

A At some point in time, that did occur to me.

Q And that Sherritt-Gordon produced it in the proper form and size for you?

A That--

MR. SPRUNG: When you say produced it, would you define what you mean?

MR. CALIMAFDE: If you have an objection, make it.

7 Dittrich - direct

MR. SPRUNG: I have an objection.

BY MR. CALIFMADE:

Q All right.

Do you know what the word "production" means? What did you ask Sherritt-Gordon to do for you?

A I asked them to produce a specific powder for me, which they did.

Q All right.

Of course. And it was of the proper form and size?

MR. SPRUNG: I don't think the witness testified to that.

MR. CALIMAFDE: I'm asking the question.

A The powder they produced for me, as I have mentioned previously, was broad range.

Q All right, sir.

We already have that on the record.

A So that I could pick out from the broad range a most desirable size of powders.

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1 Dittrich - direct

DIRECT EXAMINATION

BY MR. CALIMAFDE (Cont'd):

Q And the size is characterized in Column 5 of your patent as being powders in accordance with the invention should have a general overall shape and size of conventional flame spray powders?

A Right.

Q That's correct?

A Yes.

* * *

Q Thus, in the case of powder, the term "composite" does not include a simple mixture.

A That's correct.

Q And in accordance with the definition, the ~~inter~~-composite, the components must be in intimate contact with each other?

A Essentially reasonably, yes.

* * *

Q Will you read the definition on line 61, "Thus in the case of powder, the term composite does not include a simple mixture of individual granules of the separate components, but requires that each of the individual granules contain a separate component which will exothermically react forming intermetallic compounds"?

A All right. This then says that if they don't exothermically react, then they are not in the patent.

Q Right, sir. So is your patent concerned with a combination which is not in composite form? Is your patent --

A I am --

Q (Continuing) -- concerned with a combination which is not in composite form?

A No, sir.

Q If the heat generating mechanism is an exothermic oxidation generating mechanism, rather than an intermetallic exothermic heat generating mechanism, then that is not within the terms of your patent either, is it?

A No, sir.

* * *

Q When that powder particle fell into the heat of the flame, isn't it a fact that the binder evaporates first?

A Yes, I expect that it does.

Q That has the lowest melting point, does it not?

a Yes, sir.

* * *

Q In connection with the work for Climax ~~aluminum~~ molybdenum which you testified to during your direct examination, did you or people at Metco suggest the type of materials that you would use to coat the molydenum or did Climax molybdenum make these suggestions?

A My recollection is that we suggested some things, they suggested other things.

Q As to the nickel and aluminum combinations, who suggested those, you or Climax molybdenum?

A My recollection is that we had done work with those combinations before the Climax molybdenum work, and I believe

that we had originally suggested it to Climax.

Q Now, Mr. Dittrich, I would like to refer to the 515 patent and specifically Column 3 beginning on line 41 where you testified that you obtained these figures of the 3000 calories per gram at ~~ohm~~ 0°M, I believe, from textbooks; is that correct?

A Yes, sir. We had several textbooks that we used.

Q I show you a textbook, "Selected Values of Thermodynamic Properties."

Is this one of the textbooks which you used?

A Yes, that looks like one of them, yes.

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1 Dittrich - cross

CROSS-EXAMINATION

BY MR. SPRUNG (Contd):

Q Now, I refer to page 427. Does the textbook give you values for nickel aluminum systems?

A Yes, sir.

Q Now, Mrs. Dittrich, according to your understanding from your textbook, how much --

MR. SPRUNG: And this, for the record, is Exhibit IL.

Q Mr. Dittrich, according to your understanding, about how much aluminum would be required, in weight per cent, in a nickel aluminum combination in order to produce about 3,000 calories per gram at ~~ohm?~~

A As I recollect the figure, I believe it's about three weight per cent.

Q Three weight per cent?

A That's right.

* * *

NEXT GO TO 1186

Q Is it your understanding, in accordance with the patent, that nickel aluminum combinations, composites in the proportions disclosed in the patent, will be self-bonding?

A Yes.

* * *

Q And your -- your business employment?

A I am vice president of Kuhar Metalizing Company, Incorporated.

Q And what business are they in?

A We are in the flame spray job shop business.

Q Could you tell us what a job shop does?

A Well, basically a flame spray job shop is one who specializes in applying and finishing flame spray coatings on industrial components.

In other words, an oversimplification maybe, but we apply coatings to worn industrial parts, to OEM original equipment manufacturers parts, apply flame spray coatings and finish them and then return them to the user.

* * *

Q And could you describe the general flame spray process?

A Well, there are a number of possible processes covered in the general flame spray process. The wire metalizing process is one of the -- was one of the processes, whereby you'd have an oxi-acetylene flame. You feed a

continuous wire through the flame. Atomize the particles and then propel the particles onto the substrate by the use of a high velocity of air, that's one of the processes.

Another is the powder spray process and that can be divided into two processes really, the spraying, the cold spraying of powders and by "cold spraying" I mean that the part that you are spraying does not reach a temperature in excess of, let's say, 350 degrees.

The other process that we do with powder spraying is a -- what we call a hard surface or a spray welding process, whereby we spray the -- the powder material on in a cold form and then subsequently fuse it to the base material by high heat source, either a torch or an atmospheric controlled furnace or this type of thing.

Q Is that latter process sometimes referred to as the spray weld process?

A Spray welding, yes. There are a number of terminologies which cover it.

Q What happens if you apply any powder, just chosen at random, or any wire chosen at random to a smooth, clean surface?

A Well, basically to a smooth, clean, surface, any of the basic powders, wires, more than a thousandth or a two of coating, the coating begins to lift, even during the spray

operation. The coating will lift right off.

Q And what would happen to the part if that part was being used in service?

A Well, let's say that you applied a -- just to make it very simple, if you applied a coating to an industrial engine crank shaft and the coating came off while in service, it would tear up the entire industrial engine so that the -- the real advent of putting the material on there is to make it stay on so it will operate in service.

Q Going back to the early 1960's, when you first entered into the business, what kinds of methods were there to get the material you were flame spraying to stick to the surface?

A Well, at that time there were several methods, but basically we used about three.

One was to -- let's take, for example, that crank shaft that I told you about. One was to thread the crank shaft, undercut it and thread it using a rough threading tool and thereby creating a better surface to bond to.

Another was to basically do the same thing and then narrow the tops of it over to kind of give you anchors.

And the third process was to do a combination of either of those and use a bond coat of pure molybdenum

which bonded much better than the basic flame spray material -- the other basic flame spray materials.

We would apply three to five thousandths thick coating of pure molybdenum which would then give us an adequate bond.

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Q What kind of bond would you get when you mechanically roughened up the surface?

A Well, simply, when you -- you mechanically roughened the surface, what you basically get, in our terminology, is a mechanical bond.

Q And on the other hand, if you used molybdenum?

A Well, if you used molybdenum, you basically have a --

MR. CALIMAFDE: Your Honor, I object. There is no foundation for this man's knowledge as to what they get when they apply molybdenum to the surface.

Q As understood by men in the field in the 1960's, what type of bond --

MR. CALIMAFDE: I'm afraid that's not good enough, Mr. Kramer. It's not what was understood by people in the art.

It's whether or not this man ever had an analysis made, or whether he knows from some kind of an analysis, x-ray or otherwise, what the bonding was.

THE COURT: Well, I take it this man is being placed on the stand as an expert in the art, and the basis of your objection is that he doesn't know --

MR. CALIMAFDE: Your Honor, the basis of my objection is that it has not been established that any x-ray or other type of analysis was ever made by him in regard to the bonding that did exist between molybdenum and the substrate, and I understand from his resume that he is a person who is familiar with the job shop flame-spray spraying, which sounds more like the mechanical-type expertise, or technician's expertise.

MR. KRAMER: Let me rephrase my question, your Honor.

THE COURT: All right.

BY MR. KRAMER:

Q I'm talking now about applying molybdenum to a smooth surface. Was there an understanding in the trade among people like yourself as to the type of bond that was formed in such an instance?

A Well, first, the understanding is that the bond applied with molybdenum was adequate to do the job. That's of primary importance.

Secondly, the understanding in the trade was that molybdenum was a self-bonding material. In other words, it would bond to a substrate with no other preparation other than cleaning the substrate.

Q At that time, was there any other self-bonding material?

A Not to the best of my knowledge. Not that I know of, that was used in the industry.

Q And if no bond -- if no molybdenum or surface roughening was used, what would happen to the material flame-sprayed?

A If no surface roughening was used, or no molybdenum was used, any coatings of thickness which were of use in commercial applications, industrial applications, would lift off.

Q Could you tell me how the molybdenum was applied to the surface?

A Well, the molybdenum was basically applied with a wire metalizing gun in the manner that I talked about. It's in a wire form. It's fed through the oxyacetylene flame with either a air-type turbine drive, or an electric-type turbine drive, melted and blasted onto the surface with an atomized air.

Q Were there any drawbacks to the use of molybdenum?

A Well, there are a number of drawbacks. One is that its bond-strength, effective bond-strength, in industrial applications is limited to operating temperatures of about 600 degrees Fahrenheit. Above that, you'd begin to rapidly lose bond-strength. That was the major drawback to the use of molybdenum.

It restricted the number of applications that you could

do.

A second problem which was maybe minor, but was there nevertheless, was that molybdenum in its wire form is very difficult to use. It's a very hard wire. It is difficult to straighten, so that it will feed properly through the guns. The high degree of wear and tear on the gun parts and the nozzle. It's dirty. It's greasy to handle. It puts off a very odious fume, which was difficult to exhaust.

Although these things did not directly affect the ultimate bond that we were able to obtain with molybdenum, they were detrimental to its use.

Q Had other wires been tried to see if they were self-bonding at this time?

A Well, we were continually trying to find other materials that would self-bond. We tried basically anything that was available, but we found no other materials we could use as a bonding material in the early 60's.

Q What was the relative status of the powder flame-spray process versus the wire flame-spray process in the early 60's?

A As I've indicated, you have to divide that into what we call the cold process, and in the fusion process. The nickel-chrome-boron self-fluxing alloys were extensively used in the early 60's, whereby you sprayed the part on and subse-

quently fused it.

This was very little use of the normal range of powders that you tried to spray with the cold process. Just by spraying the cold powders on in a cold form.

MR. CALIMAFDE: What year is this he is talking about? 60's?

MR. KRAMER: Yes.

Q To what do you attribute the difference in how far the wire process had progressed, and the powder process had progressed?

A Well, basically the wire process, the applications that we could do had progressed because of the advent of molybdenum as a bond-coat. We were assured that the normal industrial applications we did, if the temperature was under 600 degrees Fahrenheit, while they were in operation, that they would bond adequately, if the material was applied properly, if the molybdenum was applied properly.

So the wire end of the flame-spray business had progressed to an adequate point, if you will, but it was -- what I called a -- kind of a dead end.

In other words, there really were not a whole new range of applications opening up because of the limitation of the bond-coat due to temperature.

Q You mentioned the fusion process. Was that

useable in all applications?

A No. There are many parts, industrial parts -- For example, go back to that crankshaft. If you try to bring that crankshaft up to 1800 degrees, to fuse the coating in, there are problems of warpage, the problems of cracking, of crystallization of the base material. So you had to be very selective on which parts you put the fuse-coating on.

Q In the early '60's, were there any self-bonding powders?

A Not to the best of my knowledge, that I used, or that was used and accepted in the industry.

Q Following the 1960's, did there come a time when there were additional self-bonding powders?

A Yes. In about 1964, Metco came out with the nickel-aluminide, what they called Metco 404, and subsequently after that, of course, came out with the 450, nickel-aluminide, and the 405, nickel-aluminide in a wire form.

Q Did the use of these nickel-aluminides open up additional applications?

A Yes. I -- To the people that were in the industry at that time, it was like a whole new avenue of business availability.

MR. CALIMAFDE: Objection to the answer, your Honor. I think this witness can speak for himself. His own job shop, not as to what happened

all over.

THE COURT: Well --

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MR. KRAMER: Your Honor, the witness has already testified that he was working with General Electric in a hundred job shops and Westinghouse and many more.

MR. CALIMAFDE: That was in 1965. He worked with Westinghouse and GE in '67.

THE WITNESS: If I may? Prior to -- to 1965 and while at Metco, field engineer for those four years, I worked extensively with companies like General Electric, Westinghouse, DuPont, Tenessee Eastman, Eastman Kodak, in helping them develop flame spray applications and helping them in the use of flame spray equipment and flame spray materials.

So that I was fairly knowledgeable about what was going on in the industry, having covered four states in the mid-West and seven states in the southeast. That was prior to 1965 when I went with Westinghouse.

BY MR. KRAMER:

Q Let me return to the original question as to whether or not the use of the nickel aluminides opened up additional applications in the flame spray field?

A Yes. One of the big areas, probably the biggest area of flame spraying that had opened up was applications

in the jet engine.

As I indicated the -- prior to the nickel aluminides, the molybdenum bond coat was not usable in temperatures of 600 degrees, and in jet engines there are many, many applications which opened up which operate in temperatures up above that 600 degree area.

One of the very first ones was the combustion cam clamps and chambers of a jet engine. An application which I had worked on for a couple -- for a year with TWA, for in excess of a year with Delta Airlines and which was a complete failure. All tests were failures and they refused to allow coating of these parts.

I'll use this as an example. Took very little testing with the nickel aluminide to convince them that was a viable material to be used in elevated temperatures and they consequently stacked in Metco 404 material and combustion cam clamps and transition ducts.

Q Could you give me some estimate of the size today of the use of flame spraying for the aircraft business?

* * *

THE COURT: Now, when you refer to these service shops, were these establishments set up to service equipment which GE and Westinghouse had supplied to users?

THE WITNESS: No. They service all types of electrical and mechanical equipment, whether it be of GE manufacture or of Westinghouse or independent manufacturer.

THE COURT: I see.

THE WITNESS: They are basically --

THE COURT: Did they actually engage in flame spraying operations in those shops?

THE WITNESS: In a very, very limited basis. They did do some flame spraying, with the wire spraying process, using the molybdenum.

One of the reasons they didn't go into it more was because of the unreliability of the process.

THE COURT: No. But I am speaking now of that period of time when the powder became available.

MR. KRAMER: Once you joined the company.

THE COURT: What use did the service shops make of flame sprayed powders?

THE WITNESS: When I went with him, after I had gone with them, both with Westinghouse and with General Electric, they began to make extensive use of the flame spray materials and basically of the nickel aluminide bonding coats.

One of the ways that I was able to convince Westinghouse to go into the business on a -- an expanded basis was that they had had failure after failure after failure of Babbitt bearings that they had tried to metalize and I went in and applied a bond coat of nickel aluminide 404 to the shell, sprayed the Babbitt up and the Division Manager at that time said, "Let's go into the business, let's really get into it."

And that was the basis that Westinghouse went into it, because they had spent years trying to develop a way of repairing Babbitt bearings other than the pouring or spin casting process.

* * *

Q Let me shift a bit.

In the -- you mentioned before that Metco sells nickel aluminide wire. Has that to any extent replaced the molybdenum wire as a self-bonding agent?

MR. CALIMAFDE: In his business?

All he can talk about --

THE COURT: Do you understand that?

In any of the businesses --

THE WITNESS: Any of the businesses which I took part in?

THE COURT: Yes. You understand the question.

Q From your personal knowledge?

A Yes.

THE COURT: His answer is "Yes," I take it?

Q Could you give an indication of approximately the amount to which it has replaced it?

A From my personal knowledge, while with -- let's just take the time with General Electric, about ninetyper cent of our apparatus service shops changed completely to nickel aluminide as a bond coating. All of the seven flame spray operations which I had direct control over used nickel aluminide as a bond coating in preference to molybdenum.

Q Could you compare the facility of application of the nickel aluminide with the molybdenum wire?

A Well, I talked about some of the problems of spraying the molybdenum wire, the problems of wear and tear on the equipment, the problems of straightening it, the problems of feeding it properly, the dust problem. With the nickel aluminide, particularly using the powdered one, it's much easier to store.

Two, it's much easier to take a can of powder and dump it into the -- into the powder hopper than it is to try to straighten wire and feed it through feed rolls.

Three, the inventory control is much easier because you can simply weigh how much you've used. You don't have a large unwieldy spool of wire to try to handle.

These things make the ease of using aluminide very

desirable.

There was not the odor, the smoke, the fumes that are involved with spraying molybdenum.

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Q Could you compare the margin of error that might be involved between the use of the molyb enum and nickel alumin~~oid~~?

A Yes, with spraying with a normal metallized gun, you are required to maintain a fairly balanced flow of oxygen and aluminum. If your oxygen goes too high you oxidize the particles and you won't get proper bonding.

Q Before you mentioned --

A I could develop that just a little more. With the nickel aluminide the parameters are very wide. With the molybdenum in many cases simply because the operator whose got the specification gets a half point too high of oxygen on his flow meter there is an effect on the bond. The nickel aluminide you really take a lot of the operator's technique out of the system because the flow can vary five or six points and you don't affect the total bond strength that much.

Q Before you mentioned several metal nickel aluminides, 404 and 450. Could you compare their application and their use?

A Basically 404, 450 and 405 are all interchangeable as far as we are concerned in our business.

In other words, they all bond readily to a clean surface. The price is about the same on all of them. We

used them interchangeably. We don't use the 404 as much now as we used it.

Q Could you tell us why?

A Because the 404 nickel aluminide had a higher flow of smoke than the 405 does.

Q Are you familiar with any other products on the market right now which are comparable to the nickel aluminide as bond coat?

A I have not used any of them. I am familiar, I believe, with exotec material that being a nickel aluminide.

* * *

Q Are you familiar with the relative bond strength of molybdenum to bond coat and the nickel aluminide?

A Yes, I am.

MR. CALIMAFDE: You'd better establish a foundation for that; otherwise, I will object.

Q What is the basis of your familiarity?

A The basis of my knowledge with bond strength in three of the complete flame sprays is we had equipment to test bond strength and were required to do so by the airlines, for General Electric, and I had occasion to submit a number of schedules to the laboratory in Schenectady of General Electric and for bond strength, integrity of the coating, and this type of thing.

I had people working for me who did bond strength tests and I had them perform numerous bond strength tests on many, many materials.

Q Including molybdenum and nickel aluminide?

A Yes.

Q What was the relative bond strength of these two materials?

A The relative bond strength of the figures we used in general were that the molybdenum was at about 2,000 psi's and the nickel aluminide, all three of them, 404, 450, and 405 wire bonded are in a range of 3,500 to 5,000 psi's.

* * *

Q Before you testified that in the early 1960's, the industry as a whole had very few new applications that appeared to be opening up; is that still the case today?

A No, the case today is quite the contrary. There are now applications opening up every day of gigantic proportion.

For example, in the automotive industry and the aircraft industry, new applications are developed every day which in the industry are worth hundreds of thousands of

dollars.

Q I would like to go back to the early '60s when you first entered into the flame spray field and you were a salesman out of the field.

Who basically were the men you were dealing with at that time?

A At that time, basically with the master mechanic or shop foreman or whoever was in charge of the plant maintenance because basically it was a maintenance thing at that time.

Q These were the people at the job shops?

A Yes. We dealt generally with the owners or the people who ran the job shop. In industry, in calling on a paper mill or textile plant, you dealt with the foreman or the master mechanic.

Q Were these the men who were the most knowledgeable about the flame spraying at that time at their shop?

MR. CALIMAFDE: That is objectionable.

THE COURT: That is calling for the operation of the witness' mind. I think it is just too broad.

Q Did you have technical discussions with people at the shop?

A Yes.

Q These were the people you had the technical discussions with?

A Yes.

* * *

Q Was there a time when you sold both the 450 and the 404?

A Yes.

Q Were you promoting one more than the other?

A No.

Q When the 404 came out, did you promote the 404?

A Definitely promoted it.

Q Was this a highly promoted product by Watco?

A I would say that, yes, it was highly promoted.

* * *

Q Did the 450 then replace the 404? In your experience now? Again I'm talking about you.

A No. There is still a considerable amount of 404 used. In my experience there were specifications for which -- which called out the 404 and specifications were simply not rewritten because there was not that much difference in the ultimate result or ultimate end of the two materials.

Q Well, how do you know there was not that much difference? Did you ever analyze the end product of the 404 and analyze the end product of the 450?

A You mean, metallurgically analyze the two?

Q Yes.

A Yes. I looked at metallurgical --

Q Have you?

A Definitely.

Q Do you know what a nickel aluminide is?

A Do I know what a nickel aluminide is?

Q Unless you're not hearing me, we're echoing each other.

Do you know what a nickel aluminide is?

A It's a material which is formed when nickel and aluminum

11 Montgomery - cross

are sprayed and the exothermic reaction takes place.

Q That's all? Is that what a nickel aluminide is to you?

A That's what it is to me, yes.

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Q And with that definition the 404 is a nickel aluminide?

A As far as I'm concerned, it is.

Q Is a 404 powder a nickel aluminide powder to start with, in your opinion?

A In my opinion, I don't really feel like that I'm qualified to say whether -- whether it's a -- what state it's in.

We in the trade, and myself, we refer to it as a nickel aluminide material.

Q You refer to the 450 as a nickel aluminide material?

A Yes, we do.

* * *

Q Mr. Axline, for the record, would you give us your address, please?

A 51 Wheatly Road, Old Westbury, New York.

Q And your present occupation?

A I'm presently Chairman of the Board of Metco, Inc.

Q And what business are they in?

A They're in the business of the manufacture of flame spray equipment and supplies.

Q Would you give us your educational background?

A I graduated from California Institute of Technology in 1931, with a BS in Mechanical Engineering.

Q And then did you go into business?

A That Summer, 1931, I was employed by the Metalizing Company of Los Angeles.

Q And what was their business?

A They were then engaged in the metalizing job shop business, which the term we used then for flame spraying.

Q What kind of jobs did they do back in 1931?

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A 1931, most of the spraying was with wire or all of the equipment -- all of the spraying that they did was with wire equipment, manufactured in Germany, and it was primarily zinc and aluminum and bronze coatings.

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DIRECT EXAMINATION

BY MR. KRAMER (Cont'd):

Q What were these coatings used for?

A They had been used for the zinc and aluminum coatings would be used for corrosion resistance. That is, spraying the inside of the tank. For example, or spraying a bridge structure. Something too large to galvanize. Anything of that type that needed corrosion protection.

Q Could you describe the metallizing gun that was used for this?

A Well, that was essentially a wire gun much as it is today, with the exception that it used hydrogen as a gas rather than acetylene, and used very fine wires. Normally 18 gauge and in the case of zinc, 15 gauge wire.

That would be about 51,000ths of an inch in diameter. 15 gauge wire.

Q And in those days, what kinds of surface preparation were available?

A When I joined them, the only surface preparation that was used was sand blasting and at some time later, they put in grit blasting equipment. But primarily they just used sandblasting.

Q What kind of jobs did you yourself personally do with that company?

A My job when I was employed was to sell metallizing jobs in the field. That is, I called on customers and tried to talk them into having something coated by metallizing.

Q And at the -- excuse me?

A Also during that period, I learned to run the equipment myself and operate it and occasionally help in spraying a job.

Q At that time, could you spray bearing shafts and similar types of equipment?

A I can't remember at all if we sprayed any of the hard metals at that time. We were engaged entirely in spraying aluminum, zinc and bronze, and as far as I can remember, there were no mechanical shapes sprayed at all, for wear purposes or brakes purposes.

Q How long did you stay at that metallizing company of Los Angeles?

A Well, I transferred -- about a few, maybe six months later, this principals of this company, formed another company, called the Mettallizing Company of America. They had been developing a flame spray gun which they were going to manufacture and my employment was transferred to this new company, to go out and sell that equipment to distributors, established distributors

around the U. S.

Q And what was your next business endeavor?

A 1933, I established the Metallizing Engineering Company, in Jersey City, to handle the distribution of equipment made by the Metallizing Company of America in the metropolitan area of New York.

Q And what has happened to that company subsequently?

A That company is now known as Metco Inc.

Q And that is the defendant in this case?

A Yes.

Q Could you give us some idea of the various methods of surface preparation that have been used over the years up to about 1945?

A Well, in -- in 1934, around that area, with the new gun which the Metallizing Company of America had made, called the 3N1 gun, it was possible to spray steel, because that gun used either hydrogen or acetylene gas and the spraying of carbon steels and stainless steels began to be done.

About that same time, Charlie Boyden, who was the chief engineer of the Metallizing Company of America at that time, made a recommendation that bonding could be accomplished by rough threading, i.e., setting a tool on a shaft and letting it chatter as you threaded

it, so you could obtain a very rough surface. And thus, it bonded on to a shaft without having to place it.

Many shops did not have blast equipment, particularly the machine shops and that was a normal market for this equipment in those days. So we were trying to get around the blasting requirement.

Q Were there any others?

A The next development was in about 1938, when the then Mettalizing Engineering Company, now Metco Inc., put out what was called a shaft preparing tool and a method of preparing surfaces using this shaft preparing too.

Essentially it was cutting grooves in a shaft and then running over a tool which was like an knurling tool to s spread those grooves so that when you sprayed in the grooves, the sprayed metal was securely anchored in those grooves.

Q And thereafter, were there any others?

A I think the next development was around 1943, '42, in that area, when we heard of a job shop in Seattle that had an electrical method of preparing surfaces.

Since preparation of surfaces and getting a good bond was always a problem in the industry, from the inception, I immediately got on a plane and went out to

see him and after some negotiation, he was using in this a job shop as a secret process. And after some negotiation, we bought the rights to that process and we did then put out equipment called ~~spray~~ fuse bond equipment, to electrically prepare a surface, we called it.

This was essentially a type of welding machine, with a number of rods which could be dragged over the surface and fused little spots of nickel on to the surface, and then that left a rough surface which could be sprayed on. This was particularly useful in hardened shafts, which up to that time, nitrited shafts, case-hardened shafts, we had no way of preparing and using metallizing.

Q Is that system still in use today to any extent?

A No. That lasted as a very fine system for about four years. During the wartime, it was very popular, used on the Burma Road to maintain equipment there. But along about 19 -- when the molybdenum wire came in, I have forgotten the exact year -- I will refer to it.

In 1947, is when they introduced and started selling what we called the spray bond wire, which was the molybdenum wire process. It very quickly took over from the electric bond process which was extremely expensive to do and it faded away and was practically never

used today.

Q Prior to the introduction of molybdenum, was there any material which could be sprayed on a smooth clean surface, which would bond to the surface?

A None that I know of.

Q Did Metco ever sell an apparatus called the E gun?

A Yes.

Q Could you describe it, please?

THE COURT: What is it?

THE WITNESS: The E gun was a -- it was the first gun that Metco made, manufactured itself, and it was a typical wire gun. It had a turbine to feed the wire. Fed the wire through a nozzle, where it was sprayed out, very much as the other guns had in the past. We put that on the market in 1936. That was the first gun we marketed.

Q Following the use of molybdenum, what was the next self-bonding material that came on the market?

A The next self-bonding material was the Metco 404 exothermic nickel aluminide powder.

Q And are there any other similar powders on the market today?

A The only one that I know of is the one sold by Eutectic.

Q Are there any additional --

A And our -- we have other powder -- the other powder we sell ourselves, which is the 450 Meco, 450 powder.

Q Now --

A We also made a wire, 405 wire, which was also exothermic nickel aluminide bonding wire.

Q Are there applications that the nickel aluminide powders can be used for that the molybdenum wire could not be used for?

A Yes. The principal drawbacks to the molybdenum wire in service was that it couldn't be used on bronze, copper alloy surfaces, as a bonding coat. It couldn't be used -- the literature says at temperatures over 600 degrees Fahrenheit, which may be a little low for safety's sake. It couldn't be used on nitrited surfaces, as a bonding coat on all of these nickel aluminide powder could be used as a bonding coat.

Q Prior to the introduction of nickel aluminide powders, were there any self-bonding powders on the market?

A Not to my knowledge.

Q Were there any powders that were being sprayed?

A Yes. Powder spraying was very old. It goes back almost as far back as the wire process and was particularly used extensively in Europe to spray zinc and aluminum. Then -- here in the U. S., it developed primarly to spray the self-fluxing alloys, which are subsequently fused.

We call the process spray welding.

Q At the beginning of the 1960's, was the powder spraying business as large as the wire spraying business?

A No.

Q And was there anything that impeded the development of the powder spray business at that time?

A In my opinion, the lack of any way of bonding the powders, except that a number of -- in a number of cases they did use the wire gun using molybdenum to get a bond coat and then subsequently spray on a powder coat.

Q Are these self-fluxing powders still in use today?

A Yes.

Q And --

A Quite extensively in use.

Q What portion of the powder spray market do they represent?

A Our best estimate is that they represent -- from our competitive data that we obtain and our own markets, that that represents about 10 per cent of the powder spraying field today.

Q Could you compare the sensitivity of the molybdenum bond coat with the nickel aluminide bond coat with respect to the skill necessary for the operator to use it?

A Well, let me say that I have not sprayed these metals. I have only watched them sprayed. But I have been informed that it is --

MR. CALIMAFDE: That's objectionable, your Honor.

THE WITNESS: All right.

THE COURT: Well, hearsay, I suppose, is inadmissible in a patent case, too.

MR. KRAMER: Okay, your Honor.

Q Has Metco come out with nickel aluminide in wire form?

A Yes. We have marked the 405 Metco 405 wire, which is nickel aluminide exothermic wire.

Q And how have the sales of the nickel

aluminide wire be compared to the molybdenum wire for use in bonding purposes?

A Well, this was a very popular wire. As soon as we put it on the -- very first year that we put it on the market, it sold over 50,000 pounds. Its a little difficult to compare the bonding field because molybdenum is used for many uses per se, as a coating, and in addition to being a bonding coat, but our estimates have been, as the most careful estimate we could make, is that the 405 wire took over about 80 per cent of the bonding market previously held by the molybdenum wire.

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DIRECT EXAMINATION

BY MR. KRAMER: (Cont.)

Q Metco sells 404 and 40 -- 450 nickel aluminide powders. Could you give me an idea of the use of them in spraying, the advantages or disadvantages, one compared to the other?

MR. CALIMAFDE: Any foundation for that, to his knowledge?

A Yes.

Q Have you seen these materials sprayed?

A I have seen them sprayed. In fact, I made the decision to put the 450 on the -- 450 powder on the market, based on what I saw. The principal advantage is that the 450 doesn't give as much smoke and dust and therefore, it can tend to be used in a more open spot than the 440.

Q Do you have access to the Metco sales figures?

A Yes. I do.

Q And what are the sales of the nickel aluminide powders today? Nickel aluminide materials today?

MR. CALIMAFDE: Does he have the sales data with him? May we see it?

THE WITNESS: I have my figures that I derived from my figures at the office. I do not have the breakdown of all this. Basic figures.

MR. CALIMAFDE: All right.

THE COURT: Are you willing to accept those?

MR. CALIMAFDE: I'll accept those.

May I see them, please.

MR. SPRUNG: May we ask that -- would you look at them and not disclose them to your client at this time?

MR. CALIMAFDE: You are about to give them.

MR. SPRUNG: What?

MR. CALIMAFDE: HE's about to give them, I understand. He's about to read them into the record.

THE WITNESS: I had a careful --

MR. SPRUNG: I'm sorry. I -- if he has any, you know, sales figures that you are not going to testify to.

MR. CALIMAFDE: What are you about to testify on the sales of nickel 404?

THE WITNESS: I'm going to -- he asked me the question of the total sales of these exothermic materials to date. As I understand. Nickel aluminide exothermic materials.

MR. CALIMAFDE: Are you going to give it 404 and 450?

A I'll give the total sales of all, is what I understood he asked for.

MR. CALIMAFDE: Well, your Honor, I object to it on two grounds: One, it's not the best evidence, although I was prepared to waive that. The other is that we contend as your Honor knows, that the 450 does not come within the scope of this patent and therefore, sales of the 450 powder should not be used in counting commercial success.

MR. KRAMER: Your Honor, we have also broken it down by the particular kind of powder.

THE COURT: But was the witness planning to give it in the broken down --

MR. KRAMER: Yes.

THE WITNESS: I am willing to, yes.

THE COURT: Oh. That obviates what I think is your objection.

THE WITNESS: First, I should say there are certain statistics that are easy to get and some that are very difficult to get. One that was easy to get was the total dollar sales of exothermic nickel aluminide materials.

This would include the wire, 450, 404 and the mixtures of where they -- powders

contained, the 450 or the 404. Those sales have exceeded 20 million dollars to date.

BY MR. KRAMER:

Q And could you break us down by 404 type, 450 type, wire type, and the powders where exothermic nickel aluminide is a portion intermixed with other powders?

THE COURT: Do I understand you to say 20 million to date from the time they were first marketed?

THE WITNESS: From the time they were introduced to the market.

THE COURT: In 1964 or thereabouts; is that correct?

THE WITNESS: Yes, sir. Yes, we have broken them down but I can only break those down by pounds, rather than dollars. So, to date, the -- of these total sales, the 404 type has been 19 percent of the pounds, sales of pounds of material. The 450 type, 27 percent. Other powders, mixtures this would be, twelve percent.

And the exothermic nickel aluminide wire, 42 percent.

BY MR. KRAMER:

Q Are you familiar in all your experience in the

business from 1931 todate with any other commercial self-bonding powders, which when sprayed will adhere to a clean smooth surface, aside fromthese nickel aluminides and the molybdenum?

A No.

MR. KRAMER: I have no further questions.

MR. CALIMAFDE: I can cross-examine in five minutes, I think.

THE COURT: Do you think so?

That's tempting.

CROSS-EXAMINATION

BY MR. CALIMAFDE:

Q Mr. Axline, as I understand your percentages powder sold, you have 42 percent of the wire, which seems to be double the 404.

Is that 405 wire, 80/20 wire?

A Yes.

Q So that the 80-20 products represents about 61 percent of the pounds material sold?

I'm adding the 405 and the 404.

A Yes. Roughly.

Q . t's roughly 61.

A I am not calculating it but I'll agree that's very close.

Q On your other powders, are those -- whose you

have 12 percent other powders, does that represent powders other than those which would form a nickel aluminide when sprayed?

A No. Those are powders which have either 404 mixed in them, as a part of the powder, or Metco 450 in them as a powder.

Q Do you have a further break down in regard to that 12 percent, whether it's half and half, 450 and 404?

A No. But if it would serve your purpose, I would make an estimate, which would be within reason. That that would be about 50/50 because many of those were spec'd in early when the 404 was the early powder.

Q Now, has the 450 gradually replaced the 404 powder?

A I would say not replaced it but it has its field of use, which is quite wide.

Q Are you selling more 450 this year than you are selling the 404?

A Yes.

Q Could you tell us how much more, -- you are looking at figures -- is it doubled, trebled or what?

A Well, roughly, it's about now, today, in the straight powders, 450, 404; 75 percent 450; 25 percent 404.

Q That's this year, from -- for 1973?

A Up to September of this year, I think I got those figures, yes.

Q That's about 75/25? Is that what you said?

A Yes; 75/25.

Q Last year, what would you estimate that to be, do you know?

A I don't. I don't know but it would have been a little higher percent 404.

Q So that gradually the 450 is replacing --

A Gradually, it has shifted, yes.

Q Now, you indicate, sir, that it would have been desirable in early 1960's, if you wish or earlier, to have had a self-bonding powder?

A Yes.

Q Now, you were in the courtroom and you probably know of your own knowledge that Mr. Dittrich had written a memo in 1955 where he said at that time if he had a composite of nickel and aluminum, he would then have the -- a basis or a powder for flame spraying? Do you recall that?

A No, I don't think I was informed of that in --

Q 1955.

A 1955, no. Let's see. '55?

Q This is when -- shortly after he was doing his work with Climax?

A Let's see. About '55 would be when? I might have known in '55, yes.

Q All right.

A Because we were getting into the powder field very actively at that time. So I was interested in all facets.

Q If it was desirable and I'm inclined to assume it was, but if it was desirable to have a self-bonding powder in 1955, why was nothing done until 1959 in regard to Metco producing an agglomerate of nickel and aluminum in the 80/20 proportions, to see whether or not this composite would work as Mr. Dittrich expected it to work?

A Well, I think I would say this is because of the history. In the early -- at the time when we were interested in getting into the powder field, the big market was the self-fluxing alloys. At that time it was probably 90 percent of the total market.

Q So there was no economic inducement at this point?

A Our first effort was to get equipment and material together into that field. Having gotten into that field, we then recognized that there were many other powders that could be sprayed that would be useful and would expand the field and then we began the development of the other powders.

Even though we brought them out almost with the gun,

our main effort was at the self-fluxing alloy field. Which was the big field then. Other than that, I know no reason why we didn't press on faster than we did.

Q No economic inducement to press on faster, is that the answer?

A Economic inducements to get -- always bonding has been one of the biggest problems in the flame spray fields. Always been a problem. We always were trying to get self-bonding materials.

Q Well, that's what strikes my curiosity, sir, because here you have the powder, at least expressed -- of a memo by Mr. Dittrich in 1955, that here it is, all that's required is something in composite form. Yet he does nothing until he hears or reads an announcement from Sherritt-Gordon in 1959.

So you have a four-year hiatus and in 1959 he obtains this powder, performs a test and the next report of his is that it works fine.

Now, when did you first offer this powder?

MR. SPRUNG: Your Honor, would you show the witness the memorandum that you are referring to? And see if it says anything about a self-bonding powder?

MR. CALIMAFDE: Well, I think we understand

what we are talking about, with regard -- you are talking about the memo that Dittrich wrote of certain work that he did and that he had in his mind that it might be a self-bonding but I don't know any report in which he --

THE COURT: Mr. Sprung, you will have an opportunity on redirect.

MR. SPRUNG: No. I just think the witness should be shown what he is talking about.

MR. CALIMAFDE: We are passed that memo anyway. We are now at the point in 1959, when Dittrich reads of an announcement by Sherritt-Gordon. He ~~invents~~ obtains the powder in '59. Indicates it's satisfactory and now another four years go by, 196-- what, '3 or '4? When Metco offered the powder, the 404? That was in 1964? Five years go by.

THE WITNESS: No.

We offered it in '63. 11*

BY MR. CALIMAFDE:

Q '63. Some four years then pass. And again, why such a long period of time?

A Sometimes it's hard to reconstruct why you make these corporate decisions, not to press on with one thing or

another but usually it's because you're hewing down some line that you think -- this is the immediate thing we should be doing and this is the next thing to do.

If it was, I don't know, remember for sure that it was brought to my attention at that time.

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Q Dr. Post, we show you a document which has been marked plaintiff's exhibit 10 and is entitled X-ray Diffraction and Electron Micro Probe Analysis of Coatings on 120 Steel Substrate, a Diffractometer Base, which has been marked plaintiff's exhibit 75 and a diffraction film, which has been marked plaintiff's exhibit 76.

I would ask if you are familiar with the document in those materials?

A Yes, yes. I have read them and I have looked at the patterns.

Q How did you acquire familiarity with them?

A How do you mean? I read these.

Q How did you physically first come in contact?

A These were given to me in your office. This was, and I studied these.

Q The two exhibits?

A Yes.

Q When was that?

A I studied them yesterday, actually.

We met the night before in your office, and yesterday I worked on them at the -- my office for a while.

Q Had you ever seen these materials prior to that time?

A No.

Q Now, have you made a detailed study of these materials?

A Yes, I have. Well, as detailed as you can in one day.

Q Now --

THE COURT: When you say "these materials," you mean the documents?

MR. SPRUNG: I am referring to the report and the exhibit 75.

THE COURT: Not the materials referred to in the document?

THE WITNESS: No.

MR. SPRUNG: No.

THE COURT: All right.

Q Now, Doctor, based on this study, do you believe that the report is a fair analysis to determine whether a nickel aluminum reaction product was present in the sample number 1, purportedly tested in the report, which is exhibit 10?

A Well, I'm hesitant, always, to be critical of other people's work, because I may not know all the circumstances.

It is a pattern which was obviously run very rapidly under --

MR. CALIMAFDE: I object, your Honor.

THE WITNESS: It's marked on the pattern, 2 degrees a minute.

MR. CALIMAFDE: Yes, but very rapidly, I don't think this man is in a position to say whether it was run rapidly or slowly.

THE WITNESS: It was run at 2 degrees a minute.

MR. CALIMAFDE: All right. That's acceptable to me.

THE COURT: Let me say this: he can, I suppose, state his general conclusions as an expert.

THE WITNESS: Yes.

MR. CALIMAFDE: Yes, sir.

THE COURT: If counsel does not bring out the reasons, particular reasons on which he bases those conclusions, you may do so on cross examination.

Why, for example, did he say rapidly, just as you did now?

THE WITNESS: Yes.

MR. SPRUNG: I'm trying to -- this is highly technical, and I'm sure that any criticism or errors will be more than adequately brought out during cross examination.

THE WITNESS: Yes.

In addition, in the Fullam Report on this diffractometer trace, they mention --

THE COURT: At what page?

THE WITNESS: I don't know that they are numbered, the pages. It's on the first page of the actual text.

THE COURT: There are a series of serial numbers.

THE WITNESS: I see. 50432. I'm sorry. I didn't know that there were page numbers. The

third paragraph.

THE COURT: All right.

THE WITNESS: They state that a standard diffractometer analysis detected only elemental nickel, and I've look at the trace handed to me, and this is the one that I was critical of a moment ago, and I see a series of numbers presumably marked by the man who ran them.

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Q Would you read those numbers off?

A Yes. 2.63, 1.76, 1.246. Quite a few. 10625. That's 1.0625. 1.0172, and in particular, I want you to note 0.951 and then three additional 1's, which I think -- is not necessary to read.

Now, these are all, but one of them are peaks that can be attributed to nickel.

The author, however, doesn't account for, nor does he mention 0.951, which is a real peak on the pattern, and which is certainly not a nickel peak, and that is inconsistent with the statement that it was -- that they detected only elemental nickel. They detected that peak. I have a pattern with me in a standard text, of a pattern of nickel, and you can use that, if you wish, to check on me.

In addition, the -- I'm surprised at the low intensity of the nickel peaks. When I am trying to ascertain whether a coating contains a relatively small amount of certain phase or compound, I run these in the way to -- that is, with high sensitivity. This can be done.

And I have run a pattern of this material and have -- clearly, the nickel peaks are many, many times more intense than those shown on this trace.

I have other criticism, but I really don't think

it's necessary to go into it in great detail, unless you want me to.

Q Doctor, you mentioned low sensitivity. May you -- is the practice to change the sensitivity of these instruments in the scans during analysis?

A Yes, it is. I --

Q And this is one of ~~thone~~ low sensitivity, in accordance with your opinion?

A Yes.

In my opinion, too, if the sensitivity were altered by simply turning a dial, you would raise the background and not achieve very much.

What you must use is techniques which minimize the background, and I have done that by using a -- what crystallographers call a crystal monchrometer. That is the beam which is scattered by the specimen, is then analyzed by a crystal, and we throw away the extraneous radiation, which are simply a nuisance, and give no information, and we are left, when you run this properly, with the relevant radiation, which, in this case, is copper K Alpha or copper K Alpha 1, sometimes. That is the type of radiation.

There are other wave lengths present, but they constitute a background, and they can be disposed of, which

is what I did when I ran the specimen.

Q Doctor, did you also study exhibit 76, which is the film?

A Yes. And --

Q Do you have any comments on the study of that?

A Yes. Well, I have several comments.

One is that scrapings from the surface can be very deceptive. I don't object to it in principle, but I don't consider it an optimum way of examining a surface.

I think it is much better to examine the surface as surface.

Now, I also find here some -- what appear to be peaks in the very low angle region, which are not mentioned by the author of the report. They are very clearly visible to me.

By and large, I agree with the fact that the author found peaks that he attributes to nickel and to an oxide of aluminum.

I don't think that the specific oxide was determined unambiguously.

I find that the agreement is somewhat better with what is called eta-aluminum, but the nomenclature is very vague on these things, and I don't think it matters.

It's an aluminum oxide in small amounts.

But, I don't think I would consider this at all conclusive, this particular type of technique.

Q Do you have any other comments which you would care to make concerning your study of the report?

A Well, I have calculated these numbers and the agreement, I find, is only fair with the location of the peaks on the chart. This can be checked very easily by anybody who wants to do so, and, in addition, I think that while I was mentioning running the peak rapidly, at 2 degrees a minute, I also feel that this pattern is much too compressed for careful analysis.

That is, I think he meant -- he has 5 degrees per inch here.

I would say 2 degrees per inch would be much better and easier to work with, and I would even take a better resolution, if -- if the time permitted.

Q Doctor, based upon your study, do you believe that the sample analyzed could have had or contained the reaction product between nickel and aluminum?

MR. CALIMAFDE: Your Honor, I'm going to object to that question.

A I can't tell.

MR. CALIMAFDE: Thank you. He answered my question.

THE COURT: I'm sorry?

MR. CALIMAFDE: I'm sorry. I was going to object, your Honor, as being --

THE COURT: I was paying attention to you and I missed the answer.

THE WITNESS: I would say the patterns are inconclusive in that regard. That's all.

MR. CALIMAFDE: Thank you.

I was going to say the question was so speculative, I don't see how he can give an opinion.

MR. SPRUNG: That's what I was driving at.

THE COURT: All right.

BY MR. SPRUNG:

Q Doctor, were you given any samples to analyze?

A Yes. Yesterday Dr. Ingham brought a specimen of -- I forget the name already. Zero -- what is it called? I've labeled it on the chart, when he gave it to me. He brought this to me at the school in my office and gave me this specimen, and asked me to prepared a chart of the specimen.

It's called Exotec, and the number on the specimen on the surface, not on the coated surface, but on the

opposite face is 1A, and I did run a diffractometer trace on this material.

MR. SPRUNG: Your Honor, this is an example of flame sprayed Exotec powder sprayed with a Rototec gun. I have discussed this with Mr. Calimafde, and we make this -- and we are going to make this specimen available to him for analysis himself.

MR. CALIMAFDE: What is the substrate?

MR. SPRUNG: What is the substrate? Mild steel.

THE COURT: How is that being identified?

MR. SPRUNG: This is marked defendants exhibit LF, which we will offer at this time, and then give to plaintiff.

THE CLERK: Defendant's exhibit LF is received in evidence.

(So marked.)

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THE COURT: It's a coated stell sample.

MR. SPRUNG: It's a steel which has been flame sprayed with the Eutectic Eute material with a Rototec gun.

DIRECT EXAMINATION

BY MR. SPRUNG: (Cont.)

Q Now, how did you analyze this specimen?

A Well, I used a technique which in essence is -- involves apparatus similar to that used by the Fullam people. But with -- well, running it under slightly different conditions, a bit more slowly. It was brought to me yesterday. I would have preferred even more time, but it would have accentuated my findings a bit.

I ran it also, and this is very important, with using a -- a crystal monochrometer to analyze the scattered beam. This is quite important when you are working with nickel, because nickel scatters a lot of extraneous radiation. This is called general nickel fluorescent scattering.

When e-radiated with a copper target --and it is for that reason that the background is so high on the Fullam chart, that is the primary reason -- it is generally recognized to be the case. By analyzing the scattered radiation and accepting only copper K-Alpha. In other words, the analyzing crystal is set to receive only copper

K-Alpha, we then have a chart of the relevant radiation, the one we wish to study unencumbered by the nickel radiation, by the general scattering from metals which are always present in apparatus of this sort. This is the chart.

Q This is the chart which we have marked Defendant's Exhibit LG?

A Yes.

Q Now, would you explain to the Court what in your opinion the analysis as shown on the diffractometer scan shows?

A Yes. Well, I think -- I presume that the sample I ran was of the -- essentially similar to the sample run at Tullum, without saying that the contents were the same, but it was a metal sample coated. But if the --if you will examine the chart, you will see that the nickel peaks are many, many times more intense than the nickel peaks on the other chart.

This is done deliberately, to bring out the presence of constituents in the coating, which obviously are not present in the same intensity, in the same amount or quantity as the nickel itself. And what I find is that we have a distorted nickel lattice, which is definitely -- contains some reaction product. That is a reaction product.

That it is not -- it does not have the lattice

constance of pure nickel. It is expanded. That's one.

The second is it contains an aluminum oxide in very small amounts, in small amounts. Very small relative to the nickel certainly. The aluminum phase, which I identified -- and I've been doing this -- this type of identification for some 25 years, and I'm also editor of the standard work referred to by the Fullam people when they identified it.

I think it is a better fit to what we call eta, e-t-a, aluminum oxide, but again, I say that that is unimportant. The peaks are marked on the charts. And we are then left with a few extraneous peaks, not accounted for by these first statements, and they correspond to peaks reported by Grant and ~~Wood~~ Wyatt in the "Journal of Metals" in ~~1959~~ 1957, as the pattern of cubic nickel aluminide, Ni_3Al. So it is present. It's very difficult to say the amount, how much, but the material is present. Aluminum oxide and the distorted nickel lattice, which is really a version of nickel aluminide.

Q From your total --

THE COURT: May I ask, so I am not confused, do I understand you to say that your analysis revealed three elements that you referred to as the distorted -- first nickel?

THE WITNESS: Nickel distorted.

THE COURT: Yes. Then you found aluminum

oxide?

THE WITNESS: Yes.

THE COURT: And then you say, also, nickel aluminide?

THE WITNESS: Yes.

Some of the peaks of the nickel aluminide overlap with those of the nickel. Nevertheless, at high angles -- and I wasn't -- I only ran to 99 degrees, because of lack of time -- but at high angles, the -- where resolution is good in the crystalographic area, the -- you begin to see the separation even of the overlapped peaks.

Let's see: 1, 2, 3, completely resolved peaks, which are -- correspond just about perfectly to the values given in the literature by Grant and whatever the other man is, in the "Journal of Metals" article. I have that here, if anyone wishes to examine it.

MR. CALIMAFDE: Just out of curiosity, is that Dr. Nicholas Grant?

THE WITNESS: I think so, because he published a fair amount in this general area and it was the "Journal of Metals." It's his field.

MR. CALIMAFDE: Thank you. I was curious.

THE WITNESS: He's the one at MIT?

MR. CALIMAFDE: Yes.

THE WITNESS: I'm pretty certain it's him but I don't recall the --

MR. CALIMAFDE: I'm sorry, Mr. Sprung. I was just curious whether it was the same doctor.

MR. SPRUNG: That's all right.

BY MR. SPRUNG:

Q Doctor, from this analysis, what would you conclude that the material is? If you had to simply say, what is the material?

A I don't like to make simple statements about complicated things but I would say that, just what I said before. It contains just nickel -- Ni_3Al, so labeled in the literature. And it contains the distorted aluminum nickel lattice, which shows clear evidence of the presence of reaction products within it.

In other words, something has entered that and distorted the lattice.

Q What would you conclude was the reaction product that distorted the lattice, the reaction produce between --

A It's an aluminide of nickel.

Q I see.

A Whatever that -- that's a rather vague term.

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Q Now, is your understanding that this was -- you said it was sprayed against the surface -- so your understanding, when you tested this, was rapidly -- would you call that rapidly quenched?

A Oh, yes. This is a very rapid quench but almost fully standard.

It is just -- it is sometimes -- I guess it is equivalent to what they call a splat cooling. That

is just -- it -- dropping a molten material on to a cooled substrate and it cools very rapidly.

Q How does that affect the nature of the material?

A Well, you see, I've been looking at that chart there, though I'm quite nearsighted and I have trouble seeing the lense of my glasses, much less that.

Q Do you want to come over to the chart?

A I recognize that. That is an equilibrium.

Q That is Plaintiff's Exhibit 66-A.

A I recognize it. I think it comes from Hanson. At least it has been reproduced in Hanson's book. That's an equilibrium diagram and I'm always bothered by efforts to -- co compare the situation that prevails when you say rapidly cool something, with the situation that is supposed to prevail under idealized equilibrium conditions. The two are grossly different.

Q How do they obtain equilibrium condition?

A Well, I don't know how it was obtained in this specific case, but in general, there is a very careful process of what they call annealing and if the man is very careful, he will take many points of any composition as "X" and approach a particular point from the low

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temperature side and the high temperature side and see if he gets the same products and eventually he's satisfied and goes on to the next point.

This goes on for a long, long while. This is an equilibrium diagram. I don't like the term "phase diagram," because it obscures --

Q What do you mean by equilibrium?

A Well, it is the ultimate, or using it in "Condition that would prevail at a given temporature." Once you've reached that, you're in the lowest energy, in the stablest state that the material presumably can be.

Q Could you obtain that sort of phase by rapidly cooling?

A Well, the answer is no.

MR. CALIMAFDE: There is no foundation for that, for this man's knowledge to answer that question.

THE WITNESS: What?

MR. SPRUNG: He's a professor of chemistry and physics.

MR. CALIMAFDE: That has nothing --

THE WITNESS: This is quite general in chemistry. We work with phase diagrams.

MR. CALIMAFDE: I don't question that you

know the phase diagram. I don't question that every chemist works with the phase diagram.

I just question the question that was put to you.

MR. SPRUNG: All right.

BY MR. SPRUNG:

Q All right.

Doctor, let me ask you this:

In your experience, over what period of time do they cool a metal to obtain these points on a phase diagram?

MR. CALIMAFDE: You see, I object, your Honor, because this witness said he doesn't know how that nickel phosphorus --

MR. SPRUNG: In phase diagrams in general.

THE WITNESS: In general?

MR. CALIMAFDE: In general we are not interested. We are interested in the nickel phase diagram.

I object.

MR. SPRUNG: I am interested.

THE COURT: Well, let me ask a few questions.

THE WITNESS: Please.

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THE COURT: You speak of that as an idealized condition.

Do you mean that each of the values shown on that are arrived at by what one might say is steptesting?

THE WITNESS: Yes.

THE COURT: That is to say, it is a composite?

THE WITNESS: Yes, of many, many steps.

THE COURT: Many, many? Each step repeating a different set of conditions but building up to the eventual picture?

THE WITNESS: Yes. You take, for example, you may prepare a dizen samples at each of, say, 20 compositions. And then each of these is taken to a specific temperature and you try to equilibriate it. This may take weeks. In many cases it takes weeks.

I may occur fairly rapidly at very high temperatures. Very slowly at lower temperatures. But you equilibriate it by whatever techniques are possible and then you have a point.

Now, obviously, it is not desirable to take an infinite number of points or you'd --

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one could spend his life at it.

So there is an entire science almost of trying to minimise the amount of work. But you must get enough points to give an adequate representation of what happens at different compositions, at different temperatures.

In other words, what that tells you is that at a certain temperature, certain phases are present. At other temperatures, you may lose them and they may go over to other phases, if you permit the atoms to re-arrange.

Now, if you cool things rapidly, this may or may not occur. It depends on how rapid rapid is. And how big the atomic or molecular units are, how cumbersome they are.

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Q You have used the word "disordered", will you explain that in further detail, sir?

A Yes, nickel aluminide, Ni_3Al, this particular nickel aluminide is a classic case of ordered disorder. It's often referred to in context with copper gold, which is the other classic case.

What happens is the follows: Pure nickel forms a face centered lattice, which has atoms at the corners of a box which we call the unit cell and atoms at the center of everyone of the six faces so what you have really is four atoms per unit cell, eight corners but each atom at each corner is a member of eight unit cells that gives one and then half or each of the six faces goes to a particular cell.

The hypothetical idealized Ni_3Al structure is one in which the aluminum atom replaces a specific one of the nickel atoms, let's say one at the center of a face, so that one

atom per unit is now aluminum and all the others are in the normal nickel positions at the corner.

This is essentially what happens here. If you have idealized conditions.

Now, if you heat this then the aluminum atom has more energy and because the -- because of the terminal enery you give the aluminum and the nickel atoms there is a tendency for them to interchange positions, for the aluminum to wander through the lattice, and we always find a tendency for increased disorder, for the aluminum not being in a specific site but being at other sites and the nickel -- in other words, at high temperatures the aluminum can be at any one of the sites. So that at very high temperatures we have a totally disordered case and it becomes rather difficult to detect a particular phase.

If you point that rapidly, if you lower the temperature very rapidly you tend to preserve that disordered phase at room temperature. This happened to some of the material, probably the bulk. In addition, it looked like some of the materials, presumably the material which is furthest removed from the substrate, and which probably had more opportunity to cool slowly, it was in contact with air and with sprayed material, it cooled a bit more slowly and that would account for the presence of -- evidence of the presence of some

ordered phase, but they are both nickel aluminide, the disordered phase and the ordered phase.

It is a rather difficult notion to get across but if you have any questions, I will be glad to answer them.

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DIRECT EXAMINATION

BY MR. STRUMP (Cont'd):

Q When nickel and aluminum combine, does a reaction occur, to your knowledge?

A Aluminum reacts with nickel, and we have all sorts of evidence for it there.

Q Is that an exothermic reaction?

A It gives off a good amount of heat.

Q If I take, say,two or three per cent aluminum and heat them together with nickel, will a reaction occur?

A Yes.

Q Will that be an exothermic reaction?

A According to the literature, it is exothermic all the way from the smallest amounts of aluminum up. There will be exothermy.

MR. CALIMAFDE: I will reserve my objection for cross-examination.

Q Is the type of reaction which occurs, say, between one or two per cent aluminum and nickel, and the reaction which occurs were, say, 20 per cent aluminum, any different from a reaction standpoint?

A You are talking about weight per cent?

Q I'm talking about weight per cent.

A Well, there is no difference if you take the experimental evidence. If you are a firm believer in stoichiometric compounds, that is, compounds of a given composition which are rarely attained, if ever, then this may bother people, but I think it is the modern view that this sort of behavior is typical rather than atypical.

The aluminum doesn't know that you have a small amount. It reacts with the nickel locally and since it is going, say, downhill in a sense, it gives off energy. It gives off heat. It's an easier -- it prefers to be in the nickel aluminide phase rather than in the separate nickel and aluminum phase.

Q Is a reaction between the nickel and aluminum in all of these reactions which forms a nickel aluminide --

MR. GRLIMAFDE: Leading.

THE WITNESS: You can give it any name you wish, but it is aluminide of nickel, but the composition varieus depending on how much you put in.

Q Now, doctor, I would like to show you or read to you a paragraph from United States Patent 3,332,515. I will give you a copy.

THE COURT: What column?

MR. SPRUNG: I am referring to Column 3, beginning on line 41.

It says: "As components, any two metals which may be melted together to form an intermetallic compound in an exothermic reaction may be used. The component should release about 3,000 calories per gram atom and preferably at least 7,500 calories per gram atom in the exothermic reaction forming the intermetallic compound."

Q Now, assuming -- a hypothetical -- assuming a system between nickle and aluminum, how much, in your opinion, aluminum would be required to react with nickel to form a nickel aluminide releasing about 3,000 calories per gram atom?

A Well, according to literature that I have examined, it would be about three or four per cent.

Q By weight?

A Yes.

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(Recess taken.)

Q You mentioned that literature indicated to you that a small percentage -- I am trying to recall the percentage you mentioned -- of aluminum which reacts with the nickel is called nickel aluminide. What percentage did you use, four percent or three percent?

A You are getting things mixed up a bit. I said that if you had three or four percent of -- weight percent of aluminum present you would give off about 3,000 calories per gram atom in reacting with the nickel. That is what I said.

Q That is assuming that you have three or four percent of the aluminum reacting with the nickel?

A Presumably yes.

* * *

Q Doctor, during your cross-examination constant reference was made to solid solution of nickel, alpha nickel. Does it matter whether in terms of the generation of an exothermic reaction, the generation of heat, does it matter whether the aluminum reacts with nickel to form a solid

solution or what you call Ni3Al; is there any difference in the type of heat that is generated?

A Well, in the literature the slope is pretty much of a constant -- I think with almost no change of slope, the amount of heat generated per atom is a constant. An individual aluminum atom does not know that you wanted to be nickel aluminide and I don't want it to be, so it reacts with something near it and we give it a label later on.

A lot of this is so semantic that it is hard for me to explain what I mean. We are discussing a term here, solid solution.

MR. CALIMAFDE: I understand you, Mr. Post. Thank you.

THE COURT: Can I say that the answer to the question is no?

THE WITNESS: It is my terse and pithy way of saying no.

* * *

Q Dr. Ingham, would you state for the record your educational background in brief summary?

A I attained a degree, B.S. in physics from Rensselaer Polytechnic Institute in 1953.

I then attended Carnegie Institute of Technology and received an M.S. in physics in 1956.

And then a Ph.D. in physics after I left there in 1958.

Q Would you briefly relate your employment

experience in the technical field since you graduated and received your Ph.D. in 1959?

A After I left Carnegie Institue of Technology, I went to the IBM Research Labs. And there I helped develop a plating process for producing the semi-conductor-type material, that is, the type of material that is used for their production of transistors.

I also at that time was studying the crystal growth mechanisms of the plating process.

A patent came out of that production which was assigned to me. And several articles were published on the physics of the crystal growth involved.

After IBM, I joined METCO, which is where I am now employed. And I joined them as Manager of the Research and Development Department.

That is my current title with substantially expanded responsibilities.

I have been active with societies. I am a member of the American Physical society; the American Ceramic Society. Under that one, I have been Chairman of the Ceramic Metals Systems Division of the American Ceramics Society.

I am a member of ASTM on a committee, and on their subcommittee related to high-temperature coatings. With that subcommittee I have been Secretary for a number of

years. That subcommittee has devised tests in areas such as testing flame sprayed coatings.

Q Doctor, will you state for the record when you joined METCO? What year?

A I joined METCO in 1960.

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Q And you have been with Metco ever since?

A Yes.

Q And what are your duties or what have been your duties at Metco on a day by day basis?

A Well, the duties are those belonging to being a manager of the research and development department.

Metco itself is in the business of developing, and manufacturing, and selling both the materials and the equipment. These relate to the flame spraying process.

And then being myself related to the R and D development means that my job has been to innovate and to be responsible for the development of the new materials and equipment. This actually ties in with developing coatings. Although Metco sells the materials and the equipment for producing the coatings, we developed the coatings in order that customers may produce those coatings with what we do sell them.

So the job involves contact on a daily basis with all phases of flame spraying, different types of guns and different types of materials involved, and spraying actually going on in the laboratory under my jurisdiction.

It goes beyond that. It brings me in contact with the marketing division, the sales people, customer problems, especially the unusual type of problems. I get into contact

with certain industries such as the automotive industry, or direct contact with piston ring manufacturers for developing materials for piston rings for automobiles, or aircraft engine manufacturers. I get into contact with the service shops, contract repair shops, repair shops such as the airlines have. When they have a problem why we very often get right into the middle of it.

My duties encompass all aspects of flame spraying.

Q Dr. Ingham, who according to your understanding are the people who are involved in the flame spray field?

A Well, these are people who may be original equipment manufacturers.

It may be people who do repairs on machinery or on engines. These are the people who are directly in the field. There are those of us who produce and sell the equipment and the materials.

We ourselves get into working with suppliers of materials, suppliers to us. These would be people who supplied us either with equipment or materials made according to our own development and specification, or they made the materials which we use as raw materials for further manufacturing powders or wires that might be used for flame spraying. And we have to work with these people.

Q You at Metco purchased powders and wires from

outside manufacturers?

A We purchased both powders and wires made according to our own specifications, rigid specifications.

These are usually materials with the specifications that are developed according to our own requirements.

Q In your opinion would you consider flame spraying as part of the powder metallurgy field?

A As I understand powder metallurgy it involves powders and processes which are used for compacting shapes.

The flame spray industry per se does not consider itself part of the so-called powder metallurgy field.

We have some contact with that field because powders are used for both industries. But powders that are made for powder metallurgy are not directly suitable for flame spray purposes. Powders have to be made according to the particular requirements of flame spraying.

We also have contacts with other fields such as the wire industry. But it is only in that the people of the wire industry will make wires for flame spraying, but these wires must be further specified in details specifically for flame spraying.

* * *

Q Now, you used the word "self bonding"; what does "self bonding" mean to you?

A Self bonding, as it means to me -- and as reflected to the flame spray industry I am sure -- self bonding means the field of a flame spray material to be attached to a substrate, providing a reliable bond. And by that I mean one that can receive a coating of material that is to be put on top and to have that coated part go into service with reliability without failure of that bond.

Q Well, now, is this term, according to your understanding conventionally used in the flame spray art?

A It is a conventional phrase, yes.

Q I would like to refer to defendant's exhibits ID, FC, GB and KK.

Would you advise me if these show the conventional usage of the word "self bonding" in the art where this term appears, referring to the exhibits one by one.

A Well, the first one on top here is Exhibit KK.

It is a can of Moguloy 1055, which they call on the label Nickel Aluminum Self Bonding Powder.

And they say it provides a self bonding base coating that automatically has a suitable surface for bonding other spray materials.

Q To your knowledge, is this one of the accused powders involved?

A I understand it to be one of the accused powders.

The next exhibit I have is ID.

These are pages out of the Welding Handbook, Sixth Edition, published by the American Welding Society.

And on page 29.8, just below the middle, there is a paragraph 2 which reads:

"Sprayed coating of molybdenum and exothermically reactive materials are widely used as bonding media.

"These materials are self bonding to thoroughly clean metal surfaces."

There is a further reference to self bonding in this on page 29.12. It talks about self bonding materials such as molybdenum or exothermics.

(continued next page.)

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Q Mr. Ingham well, when the article refers to exothermic, what is your understanding of that term?

A My understanding is that that refers to the powders described in the patents in suit where the powder is a composite made up of two metals which are metals reacting together exothermically when flame sprayed.

Q Are there any specific metals, according to your understanding, being referred to?

A Well, refers specifically to nickel and aluminum.

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Q To your knowledge, Dr. Ingham, from both your personal experience and your study of the literature, for how many years has that expression been used, "self-bonding"?

A Well, as soon as I joined the company it was in use where I was, and that, as far as I know, has been an old term.

Q That was in 1960?

A 1960.

Q Do you have any more of these exhibits which reflect on the term self-bonding?

A Exhibit FC, a brochure by Eutectic calling Exotec 240904 a pyrogenic self-bonding powder.

I have an MCA, plaintiff MCA sheet. This is Exhibit GB.

THE COURT: Defendants Exhibit GB?

THE WITNESS: There is a paragraph just below the middle which says, "Self-bonding metalizing powder Amoguloy M-55."

THE COURT: That is metalizing brochure?

THE WITNESS: Yes.

"Powder that can be applied to base metals without initial preparation."

MR. SPRUNG: These are exhibits in our books so we won't formally offer them.

THE COURT: All right.

Are there any others or is that it?

MR. SPRUNG: These are just examples that we are offering at this time to show the use of the term.

Q Dr. Ingham, when I asked you what subject matter the patents in suit relate to, you said a self-bonding flame spray material.

Now, I would like you to look at the 515 patent, and tell me, according to your understanding, what form that material should be in.

A Well, that patent discloses a composite -- composites

of several forms. It discloses materials of several forms that are in the form of a composite. And the composite may either be wire or may be powder.

The powder can be any of various types of composites. It can be an aggregate, as it says at the bottom of column 2, the last line.

At the top of column 3 it says the individual grains can be in the form of a clad composite consisting of a nucleus of at least one of the components and at least one coating layer of the other component.

Later on toward the bottom of column 4 starting with line 55, "The clad powders may be formed in any known or desired manner and preferably by the known chemical plating processes in which coating material is deposited on a seed or nucleus of another material."

At line 63, "A mode of forming the clad powders involves the depositing of themetal from a solution by reduction on a seed or nucleus such as by the hydrogen reduction of ammoniacal solutions of nickel and amonium sulphate."

Then it goes into a specific possible or mode that says -- it says here, "for the coating process."

Q Do the patents teach you what materials the composites are to be formed of?

A These composites are specifically to be formed of two or more metals which are capable of reacting together exothermically when flame sprayed, and specifically, and preferably all the way through the two metals are nickel and aluminum.

Q According to your understanding, does the term flame spray material, as it is used in the art, designate any particular form or size of material?

A Flame spray materials are, as I have said, in the form of either a powder or a wire and in either case they have to meet special requirements of size -- in the case of powder the size distribution becomes critical. It should be a relatively narrow size spread where witnin a somewhat broader but still limited possibly range of size of solution.

In case of wire there are a rather high degree of precision dimensional requirements. There is also quality requirements.

In the case of wire, if there are imperfections in the wire, such as things as spitting might occur during flame spray. So there are different requirements for a flame spray material.

Q If the material is a wire, does that necessarily make it a flame spray material?

A No.

Q What if it is a powder, does that necessarily make it a flame spray material?

A No.

Q How about powders that are conventionally used in powder metallurgy, are these necessarily flame spray powders?

A Normally they are not, as they are manufactured for the powder metallurgy industry.

The size, if nothing else, must be suited to the particular flame spray process, and, further, must be actually developed, generally on a trial basis, for the particular material involved and the coating desired.

Q Would you give us some examples of the procedures that are used at Metco to make, say, flame spray powder or convert powder that you purchase into flame spray powder?

A Well, we have a manufacturing facility with fairly extensive size distribution facilities for classifying powders at the size distribution, and we have a rather important quality control department with optical and other equipment set up for accurately measuring the size distribution of powders.

This quality control department not only maintains tabs on our own manufacturing but also on

suppliers --

* * *

MR. SPRUNG: If you are willing to stipulate that the flame spray powders are something special and not conventional powders, fine, we can drop

this now and proceed on.

MR. CALIMAFDE: Powders in accordance with the invention should have the general overall shape and size of conventional flame spray powders.

MR. SPRUNG: In that conventional flame spray powders are not powders that are generally used in metallurgy and other things.

MR. CALIMAFDE: Not the same size and shape as may be used.

MR. SPRUNG: Fine. Since we have that I will proceed. Thank you.

(continued next page.)

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Q Were flame spray powders or materials in the form of aggragates, to your knowledge, known prior to the date of the patents in suit?

A Yes.

* * *

I can't see anyone who would be any more qualified to testify as to that.

MR. CALIMAFDE: That's hearsay, my friend.

MR. SPRUNG: He studied the prior art.

THE COURT: You will have to pardon me because I thought the reference that he previously testified to were all read from the patent itself, and all of a sudden you surprise me by going back to 1960.

MR. SPRUNG: The date of the patent is 1960, the effective date.

THE COURT: I see. You mean it goes back when issued to the date of first filing, is that the point?

MR. SPRUNG: Yes. The patent has an effective date as of its first filing.

THE COURT: Has it been established that this witness had read the earlier application?

BY MR. SPRUNG:

Q Dr. Ingham, from what period of time have you studied the art and patents concerning the flame spray field? How far back have you read patents relating -- patents and literature relating to the flame spray field?

A Back to the early 1900's.

Q According to your understanding, were flame spray materials in the form of composites known prior to the filing date of these patents?

A Yes.

Q From your reading of the patents, is there any acknowledgement of that in the patents themselves?

A Well, on column 2 line 26 through 29, in the case of flame spray powders, while powders formed of several constituents were known, the same were generally in the form of a powder mixture of the individual constituents, or, at best, a particle aggregate.

Q Is an aggregate a composite?

A So that says an aggregate was known, and aggregate is a conglomerate, a composite.

Q Dr. Ingham, according to your knowledge and your study of the literature of the flame spray field going back to the 1900's, were flame spray materials which would go -- undergo an exothermic reaction when sprayed known prior to the filing date of this patent?

A Exothermically reacting materials of the -- what I would call the thermit type were known prior to this date. That is acknowledged in here in this 515 patent.

Column 6, say, starting at line 9 "This is to be distinguished from flame spray processes and materials in which

heat is generated by a reaction such as an oxidation reaction in which a foreign and non-metallic element is introduced and in which undesirable components may be produced."

That would refer to the kind of oxidation reaction where a material is in there in the form of an oxide, such as iron oxide, and then a metal, such as aluminum, which can reduce the iron oxide in an oxidation reaction, and that was the known type of art that this would refer to.

* * *

A I consider that it is the entire sentence of claim 4, which describes something that was new in the flame spray industry. I consider that what was new was the forming of the nickel and aluminum into a composite in such a way that composite can be flame sprayed and in such a way that heat is generated by the reaction of the aluminum and nickel and if that occurs in such a way as to achieve a result which, as it says here in words, aids in bonding to the subject matter that is being coated.

Q What is your understanding of the patent of the term, "aids in bonding"?

A "Aids in bonding," is a fairly simple English phrase but in the patents there is considerable discussion of nickel and aluminum composites, self-bonding, and I think we went through that definition and it, unless the patent discusses the fact that the -- let me back off and say that self-bonding -- I don't know if we emphasized this, but it includes that particular phrase, that particular phrase includes the particular phrase of spraying onto just a clean, smooth surface, that is what self-bonding tends to refer to in achieving a good reliable bond; however, in the flame spray

industry and this is acknowledged in the patent, here I refer to column 7, near the bottom -- excuse me, I do not have the right reference that I was intending.

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THE COURT: Are you referring to that portion up around line 23 column 7.

Q Refer to example 2.

A I will tell you what I am specifically looking for. It's where other surface preparations may be used.

MR. CALIMAFDE: That appears in the examples. You mean the examples or in the spec?

MR. SPRUNG: The examples are part of the spec.

MR. CALIMAFDE: The examples talk about --

Q I think Example 2 gives some examples of that.

A Well, example 2 does give various ways of preparing substrate, and it is certainly common in the flame spraying -- incidentally, other examples all the way through give all kinds -- not all kinds, but give various ways of preparing the substrate; that includes rough grit blasting, and so on.

And in flame spraying it is common to put -- to prepare a surface as much as possible in order to be as redundant as possible; in order to have the most reliability out of a bond.

So back to the phrase, "aids in bonding." That carries it further than just self-bonding, but means that one can get a better bond by applying it to either a smooth ground or just clean surface, or any of the other normally

recognized methods of preparing for flame spraying.

THE COURT: Now, in view of the witness' answer I think this may have come up once before, but isn't there being described here a way of doing something that amounts to what one might call an improved process?

MR. SPRUNG: Well, the claim, your Honor, has what we call a characteristic clause ~~period~~. In other words, it is a functional statement. It says what will inherently result when you use this material as it is intended to be used.

In other words, we do have a process patent which is --

THE COURT: I understand. But I am trying to see what --

MR. SPRUNG: In other words, let's take a new pharmaceutical. If you have a new pharmaceutical it may cure pneumonia. It has this inherent characteristic if someone takes it.

You may put in a claim if you want the composition so-and-so and then what we call a characterized clause; characterized by its pharmaceutical activity in fighting pneumonia.

What this is characterized -- in other

words, once you make the flame spray material, it has this characteristic and the claim merely helps when reading it understand what it is all about.

THE COURT: Well, yes, I can understand that.

MR. SPRUNG: It is a functional statement, we call it.

THE COURT: A functional statement.

MR. SPRUNG: It describes what the intended function of the composite is, the flame spray material. It has this characteristic when it is used. But it is still a spray product claim. It is still just claiming the flame spray material itself.

THE COURT: If that is so, what do you really get down to that one might consider to be something new about this?

MR. SPRUNG: What is new about this, as far as this claim goes, is a flame spray material in the form of composite containing -- this is the crystal point -- nickel and aluminum. No one has made a flame spray composite with the components nickel and aluminum. By putting these

two specific materials together they do something over and above what other flame spray materials do. In other words, somehow when it is flame sprayed these materials react with each other and in this reactive state they will stick to a surface and be self-bonding.

Certainly, if someone else taught a flame spray material of nickel and alumin m they would anticipate the claim, if it was capable of doing this. But the whole art does not.

They have a general cladding patent and then they are trying to put other patents together to teach that it would be obvious to put these two materials. It's our whole contention that there is nothing in the art which would tell the artisan, "Look, I take aluminum on one hand and nickel on the other and put them together and I am going to get something I never got before, a self-bonding material that is better than molybdenum and solves all the problems of molybdenum."

That's the whole point of this. It is the fact that no one recognized by putting these two specific materials together you would get a superior flame spray material and no one taught

putting these materials together as a flame spray material. That is the whole crux.

THE COURT: Let me ask you one thing, then, but in addition to the two metals you mentioned, wasn't another aspect that their arrangement be such as to --

MR. SPRUNG: That is a composite. It is a known form.

We are saying by putting nickel and aluminum in a composite form, composites were known, but putting nickel and aluminum together in the composite form we have an entirely new material that produces new and unexpected results, and that's what the patent system is all about.

We admit composites were known. We don't think the particular clad-type in this association was known, but assuming composites are known, our invention is the discovery that of all the wealth of materials that you could pick and select to make a composite, the selection of these two specific materials will produce this completely new, unexpected and revolutionary result. And that's what is not taught in the art. That's what this

is all about and that's what I have been trying to get.

This makes a self-bonding material, and the words "aids in bonding" is naturally used because you don't want to give the impression that it is only used on a smooth surface; it is conventional to help bonding with other bonding methods.

THE COURT: So that is really the essence, the combining of nickel and aluminum in a manner which enabled the combined nickel and aluminum to be --

MR. SPRUNG: No one put nickel and aluminum together as a composite for a flame spray material, and no one had a self-bonding material other than molybdenum. It's as simple as that.

The Maskiw patent has a cladding method, and which has 450 combinations of which you could extract nickel and aluminum and then convert it to a flame spray field -- but we say that as a matter of law that is not anticipatory.

All the other references they are just trying to say you take materials that react exothermically are known, composites are known,

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it's known that nickel and aluminum react exothermically, so why shouldn't we put it together? The reason is there is no reason, no one would suspect that you would get a self-bonding material and no one taught putting these specific materials together in this form for flame spraying. That is it.

THE COURT: You may go on with your examination.

BY MR. SPRUNG:

Q Dr. Ingham, you testified that it was known in the flame spray art that self-bonding materials might be used to aid bonding in conjunction with other conventional bonding methods such as surface preparation.

Would you give us some examples of that, and I refer to Exhibit ID and IA. Do you have that exhibit available?

THE COURT: Is that the handbook?

MR. SPRUNG: Yes.

MR. CALIMAFDE: That IA?

THE WITNESS: ID.

THE COURT: ID.

MR. SPRUNG: The Court has the only copy. But you have your own copy?

MR. CALIMAFDE: Yes.

MR. SPRUNG: IA is a metallizing handbook. The metallizing handbook -- the Metco handbook, your Honor, is a -- the witness is first testifying to ID, which is the welding handbook.

MR. CALIMAFDE: Is this in regard to preparation?

BY MR. SPRUNG:

Q I might refer to 29.8 and 29.12.

A As I said earlier, it is common to use various roughening or cleaning procedures to prepare a surface to receive a flame spray material. It is common to use a self-bonding material on top of such a prepared surface in order to get maximum reliability of a flame spray coated part.

As an illustration of the fact that this is known I can refer to this welding handbook, Exhibit ID, and on page 29.12 it says, "Self-bonding material such as molybdenum or exothermics may be sprayed directly onto a smooth, clean surface but better adherence is obtained if a grit blast is used first. This method produces a fusion-type bond. On shaft build-up it is common to increase the bond area and improve the adherence of the coating by cutting a 20 to 30 pitch thread on the area before application of self-bonding materials."

MR. SPRUNG: Your Honor, may we borrow

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the Metco handbook? That is the only copy we have.

THE COURT: This one?

MR. SPRUNG: Yes.

THE COURT: Yes.

(continued next page)

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BY MR. SPRUNG:

Q Will you just tell us briefly where if anyplace in that book there is talk of conventional surface preparation with use of a self-bonding material?

A Exhibit IA -- I am going to have to browse a bit to find the location. It would be under the section on surface preparation. The pages starting on A9 speaks of different kinds of surface preparations, including the spray bond wire surface preparation.

Spray bond is the self-bonding Molybdenum. This book was published in 1964, this handbook, and so it refers primarily to Molybdenum rather than these other self-bonding materials.

On page A10 it suggests the effect of grooves on the spray bond wire preparation -- spray bond wire spraying. Under a chart on page A39 it gives bond strength. Chart A lists bond strength with the surface preparation called thread and spray bond. These occur all the way through.

Q I think that is sufficient.

Now, Dr. Ingham, according to your understanding of the patent, what does the term "composite" designate with respect to a powder, first?

A To use the terms of the patent " a structurally integral unit." To me that means that the material, if it is in the

form of a powder, then it can be fed into the flame through from the powder hopper into the flame and consists of the several constituents that are supposed to make up the composite.

It stays as a structurally integral unit as it is fed into the flame.

Q Is a mixture a composite?

A A mixture would not be a composite because each individual particle gets fed into the flame individually and there is no chance for the -- those individual particles to come together in the flame.

Q Now, in the case of a wire, what does the term composite mean to you, in accordance with your understanding of the patent?

A Well, this will mean that the composite wire has to achieve similar results; that is, feeding both constituents into the flame together and simultaneously.

Now, the wire process actually operates a little different from the powder spraying process.

In the powder process the relatively cool powders go from the powder hopper into the flame as individual powder particles.

In the case of the wire, the wire goes through the center of the torch tip and then the end of the wire is melted

off and there is a blast of air which atomizes; it's like an atomizer gun process. It atomizes the droplets from the solid tip of the wire. So that in the case of the wire there has to be -- in the case of a composite wire there has to be a very close contact between the constituents of the composites so they are melted off together and can atomize off in such a way that each atomized particle contains both constituents.

* * *

BY MR. SPRUNG:

Q Dr. Ingham, according to your understanding, is there any distinction made in the patent between the degree of contact of the nickel and aluminum in a wire as opposed to powder granules?

A Generally it has to be -- it is told in here to be more intimate in the case of the wire. Because of that concept that the particles are atomized off the end of the wire tip, there has to be a greater degree of integrity involved, and that is mentioned here in reference to the wire, the degree of intime contact, which is more important than with the powder.

Q As opposed to a wire, in accordance with your understanding, do the nickel and aluminum have to be in intimate contact in a composite powder?

A The word intimate is relative here. The degree of contact need not be as much. They have to be together, but the degree of contact does not have to be as great.

Q Does the patent teach any form of powder composites in which the individual granules or parts of nickel and aluminum do not touch each other physically?

A I think that would be in the situation where the -- under this mode of cladding aluminum particles onto the core of the nickel nucleus using a binder.

Q Will you give us the specific portions that you are referring to in example.

A This is the preferred and greatly simplified mode. This is our column 5 at the top. It describes the coating or depositing of one component as a coating in the form of a paint on the other component. Thus, one of the components which is to form the coating or cladding may be dispersed in finely divided form in a binder or lacquer so as in effect to form a paint in which this component corresponds to the pigment.

The paint is then used to coat the core particles of the other component in the binder or lacquer and allowed to set dry. The binder is probably a resin.

In Example 31 -- Example 31 is an example that is specific to nickel and aluminum and tells in more detail how to manufacture a powder of that type. This is column 13, line 67, 68. "All of the nickel core particles were clad with a dry film which consisted of aluminum particles bonded to each other and to the core material by the phenolic binder." The general picture here is that there is a nickel core with a coating of resin and there are aluminum particles dispersed in this resin.

Q Now, I would refer you to column 16, line 59 through 64, which is the claim 14 we were referring to.

Does that, according to your understanding, describe any type of structure made in accordance with any example of the patent?

A That would describe just what I was talking about with respect to the column 5 at the top, and more specifically the example of 31, which includes the aluminum and nickel.

It says, "Finely divided aluminum particles bound to the nucleus with a binder." That is referring to that same example.

Q According to your understanding, Dr. Ingham, is it conventional in the art to refer to the powder having this structure which you just described as a composite powder or clad powder?

MR. CALIMAFDE: I object, your Honor. There is an absence of foundation for that answer, or to elicit that answer.

MR. SPRUNG: He's been working in the art for ten years -- we will get into the documents on this, your Honor.

Q Let me refer you to Exhibits FA, FL, FR and IS.

THE COURT: What is the first one?

MR. SPRUNG: FA.

A FA refers -- is a Eutectic brochure. On page 149, Exotec 29904, which I understand to be one of the powders in

suit here. That is called a composite powder.

Q Have you studied the structure of the Exotec material?

A Yes. I have looked at Exotec 29904 and it would appear to be --well, to look just like our Metco 450 and to look as if it was made according to that example 31.

MR. CALIMAFDE: I object.

A Except for percentages of ~~ammonia~~ aluminum.

Q What is the form? Never mind how it was made.

A This was a clad composite form.

Q Will you describe physically what the form --

A A nucleus of nickel, and there are particles of aluminum distributed around the outside in a binder.

Q Would you proceed then.

A This Exhibit FL, another Eutectic brochure --my numbering is not very clear here, I think it is page 58 -- is it 868?

MR. CALIMAFDE: I will stipulate, Mr. Sprung, Eutectic refers to its Exotec powder as a composite in its advertising literature.

MR. SPRUNG: Do we have anything that is not Lutectic here?

Q We have there patent number 3655425. Does that refer to a patent?

Q Dr. Ingham, according to your understanding of the patent what happens when you flame spray a composite powder made in accordance with this procedure and having this structure, in other words, the nickel core with the binding coating, with aluminum in the binder?

A Well, I visualize a sequence of events --

Q Well, just in general.

A In general the --

Q What I'm trying to get at is what does the patent teach occurs when you flame spray that powder?

A It teaches that there is an exothermic reaction between the aluminum and nickel during the flame spray. And that this teaches that one obtains an ~~approved~~ good bond as a result of this.

* * *

Q Was there any, according to your general understanding as used in the flame spray art of an intermetallic compound between nickel and aluminum -- are there any necessary proportions between nickel and aluminum in order to form an intermetallic compound?

A No, because the aluminum as it react with the nickel, the amount of heat given off is -- the amount of heat given off per atom of aluminum or per incremental amount of aluminum, the amount of heat is almost entirely independent of the amount of aluminum put in, whether it is a little tiny bit of aluminum, one atom of aluminum, or equal amounts of aluminum or nickel, or anywhere inbetween.

Q Now, you are familiar with plaintiff's exhibit 66 ASE which is a faze diagram?

A Yes.

Q Do you consider that you would be required to have any specific proportions of nickel and aluminum as fallin

within that diagram to form an intermetallic compound in accordance with your understand of the patent?

A Well, a ~~faze~~ diagram is just that. It is a diagram of ~~fazes~~ on that commonly known and published diagram, or marked off different fazes, and those ~~fazes~~ are determined by -- under what is known as equilibrium conditions. Equilibrium means that one has to wait long enough for the entire system to come to its lowest form of energy, its balance point.

Now, with respect to intermetallic compounds, those are just different ~~fazes~~ on that diagram.

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Q Are there or are there not those stoichiometric proportions required to make specific types.

A Stoichiometric compounds are ones which apply to certain ratios, low number of ratios of, in this case, nickel and aluminum.

There is the stoichiometric compound NIAL, referring to that portion of -- that one to one proportion of aluminum nickel.

There is the stoichiometric compound NIAL3, meaning three atoms of aluminum and one of nickel.

There is the NI3AL, meaning three nickel and one aluminum.

Q Now, in accordance with your understand of the patent, does the term intermetallic compound require the stoichiometric compound?

A No, it definitely states otherwise with respect to the patents that those stoichiometric compounds --

Q Would you point out where?

A (Continuing) -- are not required.

In Column 3, let's start at Line 41:

"...as the components any two metallics which may be melted together to form an intermetallic compound in an exothermic reaction may be used. Components should release about 3,000 calories per gram atom and preferably 7500 calories

per gram atom in the exothermic reaction forming the intermetallic compound..."

Now, jumping through the definition of calories per gram atom:

"...while the components are preferably present in the stoichiometric proportions required for the formation of the intermetallic compound, it is however possible to also have an excess one or the other provided the relative amounts are sufficient to release the quantities of heat indicated above in the formation of inetermetallic compounds ...

Q Now, with respect to aluminum and nickel, what does the patent teach, according to your understanding, is the minimum amount of aluminum in relation to nickel?

A Well, if one used the 3,000 calories per gram atom then it is possible to look up in the literature and see whether this corresponds to some three or four percent, three and a half percent of aluminum with respect to the nickel.

Q Is that by weight?

A That is weight percent, yes.

Q Would you give us some other examples of the literature which you just referred to, and I refer to Exhibits IL and IV?

A Well, some of this literature was brought out in

earlier testimony here.

IL is a few pages out of a book edited by Hultgren, and --

Q What is the copyright on that?

A The book itself was 1963.

Now, there is data in it that quotes several other references.

Q Do you know whether there was an earlier edition of that book?

A I'm not familiar with that.

There are -- I brought a book up here with me which constitutes another reference and it also gives data.

This is a book -- I think it will be Exhibit IX.

Q IX?

A It is this book (indicating) which we have had and on Pages 51 of that book -- the book is by Kubaschewski. That book was published in 1956. And that has data on the amount of heat which is given off when aluminum and nickel are reacted together. And it includes data at 5 atomic percent aluminum.

Q Which is what weight?

A Which is about half that, about two and a half weight percent.

Q How much heat is that?

A That is quoted as 1900 calories per gram atom. And

it has a figure of 10 atomic percent, which is about 5 weight percent. And it gives 3700 calories per gram atom.

Now, these book figures are accumulations of other peoples data. Let's go back to the -- well, they refer to other -- to more original references. There are two which are referred to from the books.

Q Refer to the exhibit number when you say "these books"?

A All right, IL and IX refer back to -- together refer back to two other references, and one is by Oelsen and Middel. That reference is IV.

Q IV1?

A IV1 is a specific page out of Oelsen and Middel, and it shows that data plotted as a line. And by that data I mean that the heat generated by the reaction between nickel and aluminum is given as against the atomic percent of aluminum.

Q What page are you working off now in the Oelsen book?

A This would be Page 15 of the article itself.

Q Now, that is in German, is it not?

A Yes.

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